

01

Course Overview

Notice

- **Author**

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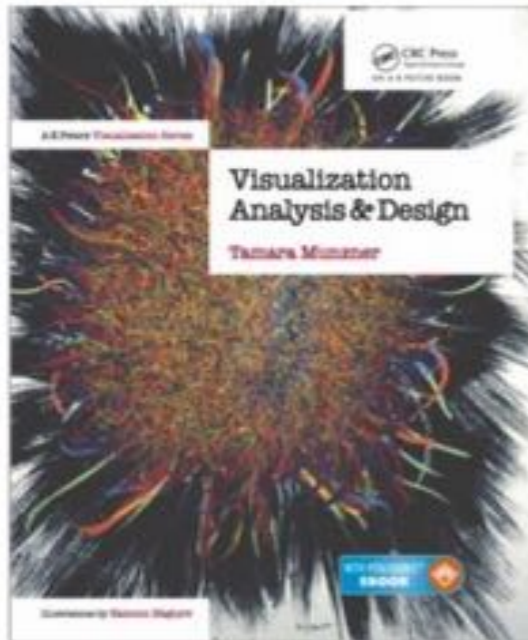
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Bibliography

- Many examples are extracted and adapted from:



Interactive Data Visualization: Foundations, Techniques, and Applications
Matthew O. Ward, Georges Grinstein, Daniel Keim
2015, 2nd Edition
ISBN: 9781482257373
ISBN (e-Book): 9781482257397



Visualization Analysis & Design
Tamara Munzner
2015,
ISBN: 9781466508910
ISBN (e-Book): 9781498707763

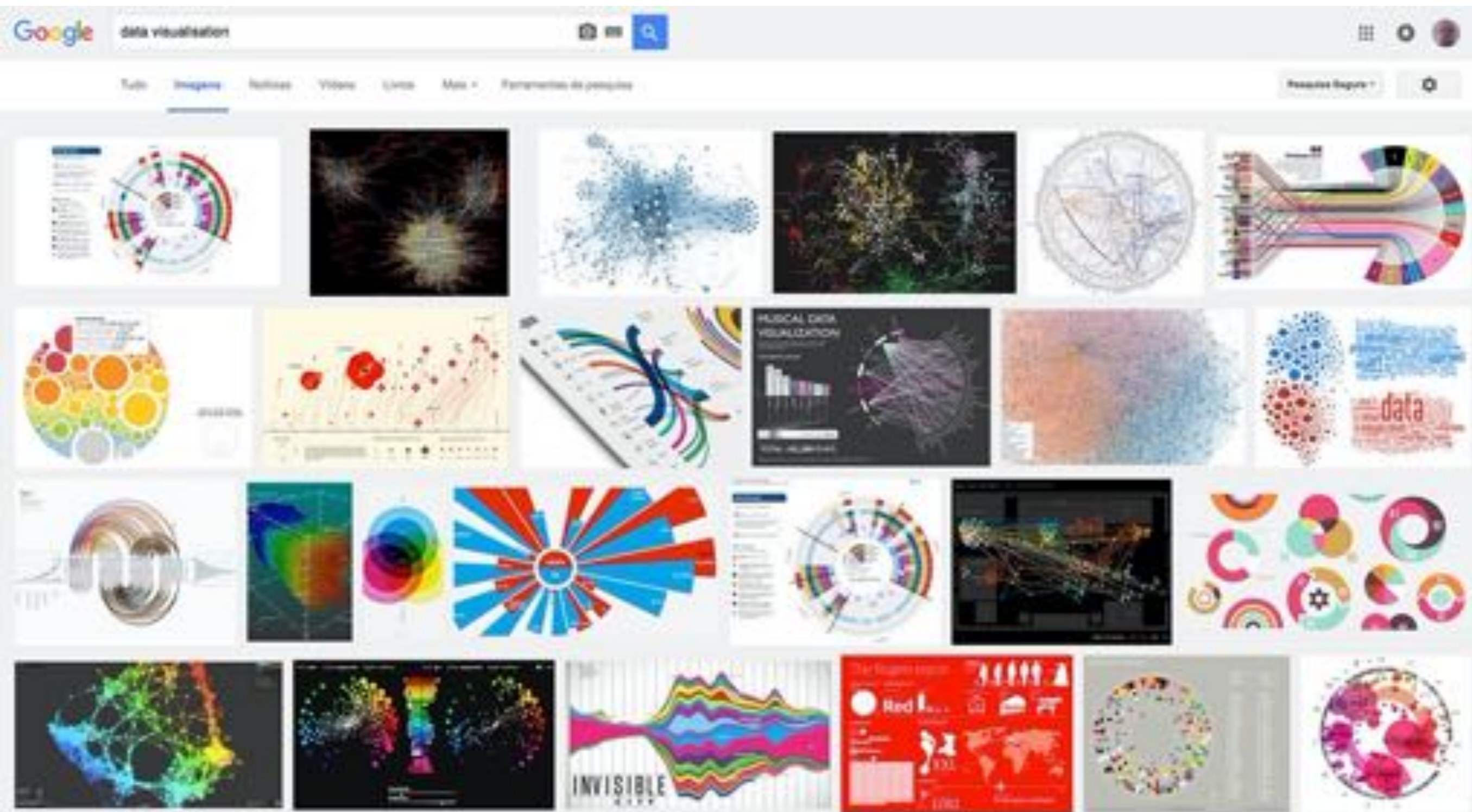
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- Landmarks of (Data) Visualization
- What is (Data) Visualization?
- Why (data) visualization is important?
- What is the core idea of Data Visualization?
- (Data) Visualization today
- (Data) Visualization and other fields

- Course Organization and Overview
 - ◆ Syllabus; Bibliography; Evaluation rules; important dates, etc.

Ask google for Data Vis (images)

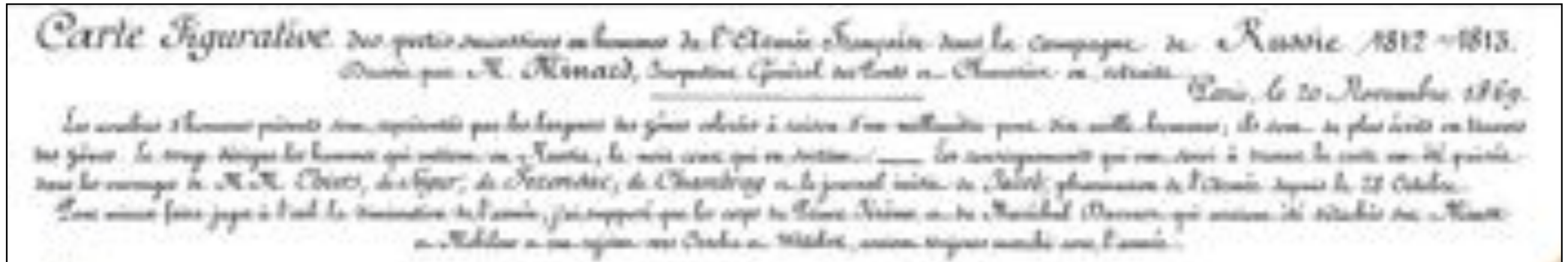
Ask google for Data Vis (images)



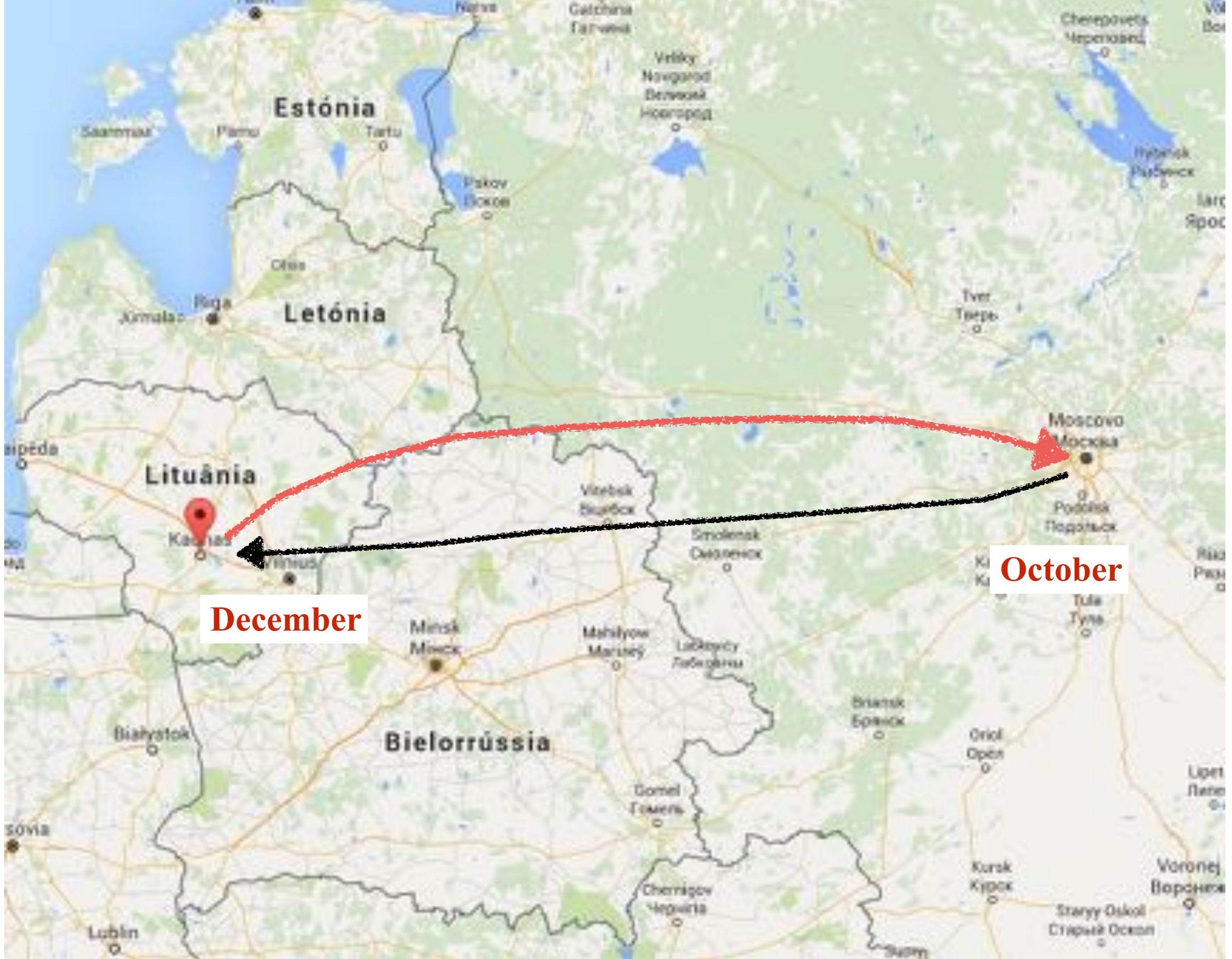
Landmarks of (Data) Visualization

Landmarks in Visualization

- Charles Minard's map of Napoleon's disastrous Russian campaign of 1812



- Carte Figurative des **pertes successives en hommes de l'armée Française** dans la campagne de Russie 1812-1813
- Le **nombre d'hommes** présents sont représentés par les **largeurs des zones colorés** à raison d'un millimètre pour dix mille hommes au travers des zones.
- Le “rouge” désignent des hommes qui entrem en Russie, le noir ceux qui en sorte
- Les renseignements qui on servit [References]

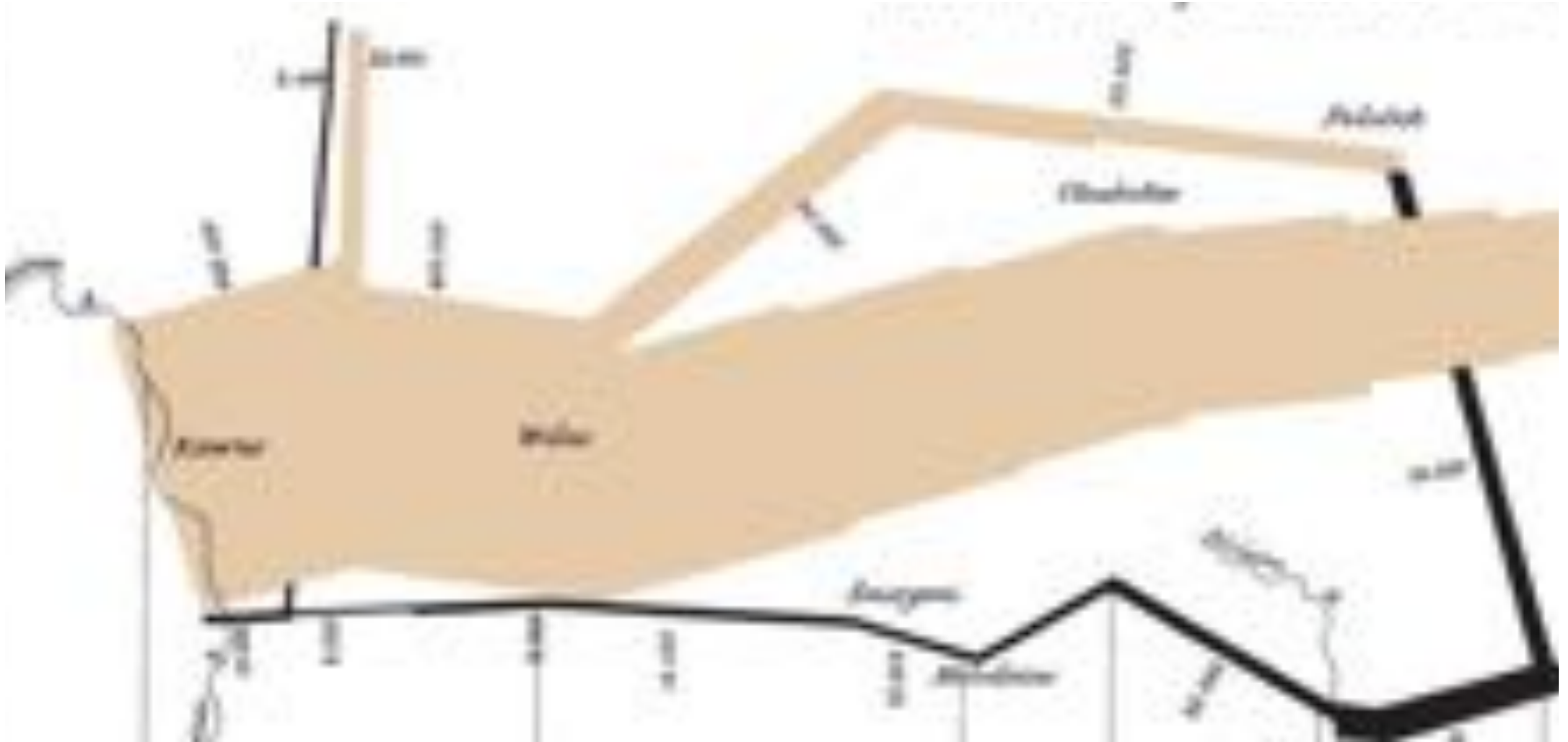


December

October

Landmarks in Visualization

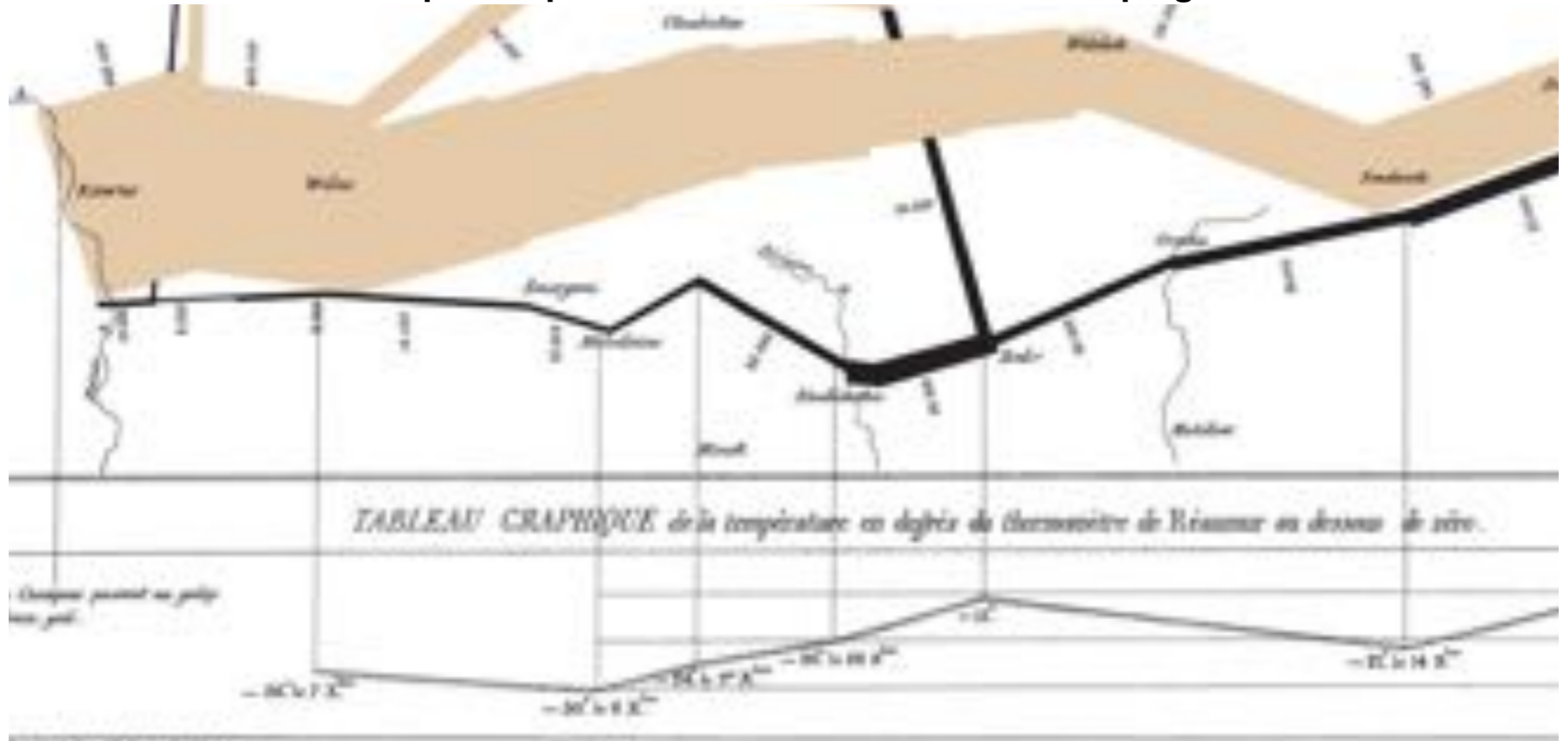
- Charles Minard's map of Napoleon's disastrous Russian campaign of 1812.



Six different sets of data: **geography**, the army's **course**, the army's **direction**; the **number of soldiers** remaining; **temperature**; **time**.

Landmarks in Visualization

- Charles Minard's map of Napoleon's disastrous Russian campaign of 1812.



Six different sets of data: **geography**, the army's **course**, the army's **direction**; the **number of soldiers** remaining; **temperature**; **time**.

Landmarks in Visualization

- **Broad Street cholera outbreak, (John Snow, 1854)**





Early visualizations

- **Recommended readings:**

- ◆ **(Matthew O. Ward et al, 2010) pages 6 - 15.**
- ◆ **See the suggested links at the end.**

- **Some “Landmarks”:**

- ◆ **Broad Street cholera outbreak, by John Snow, 1854.**
- ◆ **Charles Minard's map of Napoleon's disastrous Russian campaign of 1812.**
- ◆ **William Playfair founder of graphical methods of statistics.**
- ◆ **Florence Nightingale's “Rose” representing the causes of mortality in the army.**
- ◆ **Periodic Table: Dmitri Mendeleev (1869); Julius Lothar Meyer (1870).**

What is (Data) Visualization?

Modes of Visualization

Interactive Visualization

- Used for discovery
- Intended for a single investigator or collaborators
- Rerenders based on input
- Prototype quality

Presentation Visualization

- Used for communication
- Intended for large group or mass audience
- Does not support user input
- Highly polished

Interactive Storytelling

- Presentations via interactive webpages

Modes of Visualization

Modes of Visualization

John C. Hart

Visualization Mode	User Interaction	Graphics Rendering	Target	Medium
Interactive Visualization	User controls everything, including dataset	Real-time rendering	Individual or collaborators	Software or internet
Interactive Storytelling	User can filter or inspect details of preset datasets	Real-time rendering	Mass audience	Internet or kiosk
Presentation Visualization	User only observes	Precomputed rendering	Colleagues, mass audience	Slide shows, video

What is the Goal of Data Visualization?

The (ultimate) goal of DV

“Data visualization is **not just about seeing** data !

Is about **UNDERSTANDING** data,

and being able to **make decisions** based on the data”

by John C. Hart

What is the Goal of Data Visualization?



What is the Goal of Data Visualization?

“Data visualization is **not just about seeing** data !



The concerns of Data Visualization field

- Visualization provides an **alternative** or a **supplement** for **textual or verbal information**
 - (**in many situations**) Visualization provides a richer description of information than the word-based counterpart !
-
- Why?
 - In what kinds of situations are visualizations effective?
 - What type of information can and cannot be visualized?
 - How many different ways are there to show the same data? **Which ones are best for particular circumstances?**
 - Why should we study visualization?

Why (data) visualization is important?

Why (data) visualization is important?

Anscombe's Quartet: Raw Data

1		2		3		4	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

Why (data) visualization is important?

Anscombe's Quartet: Raw Data

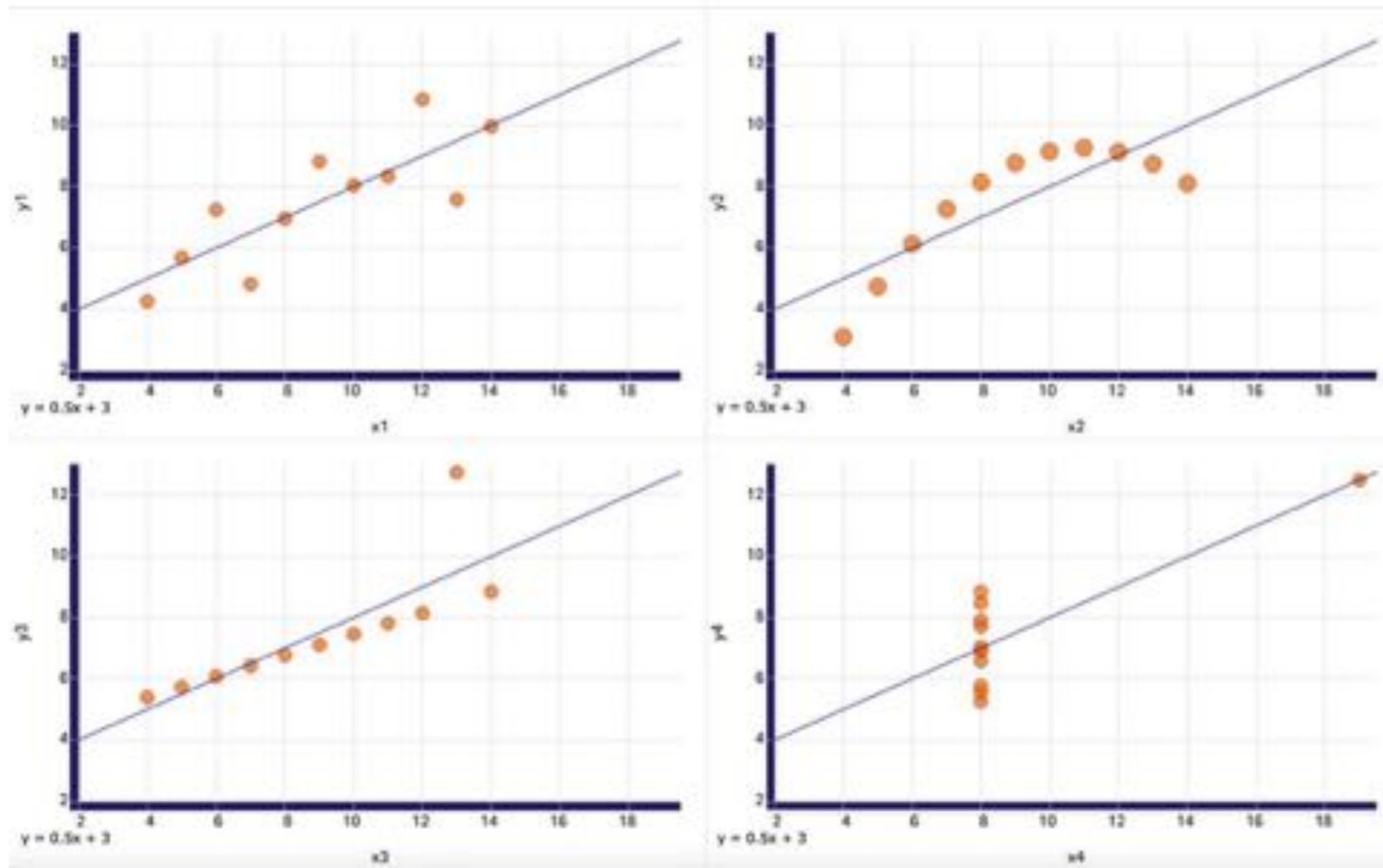
	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
	10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
	8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
	13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
	9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
	11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
	14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
	6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
	4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
	12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
	7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
	5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89
Mean	9.0	7.5	9.0	7.5	9.0	7.5	9.0	7.5
Variance	10.0	3.75	10.0	3.75	10.0	3.75	10.0	3.75
Correlation	0.816		0.816		0.816		0.816	

4 datasets
2 variables, 11 rows

Property	Value
Mean of X	9
Variance of X	11
Mean of Y	7.5
Variance of Y	4.1
Correlation	0.816
Linear Regression	$y = 3.0 + 0.5x$

F. J. Anscombe (1973)

Why (data) visualization is important?



4 datasets
2 variables, 11 rows

Property	Value
Mean of X	9
Variance of X	11
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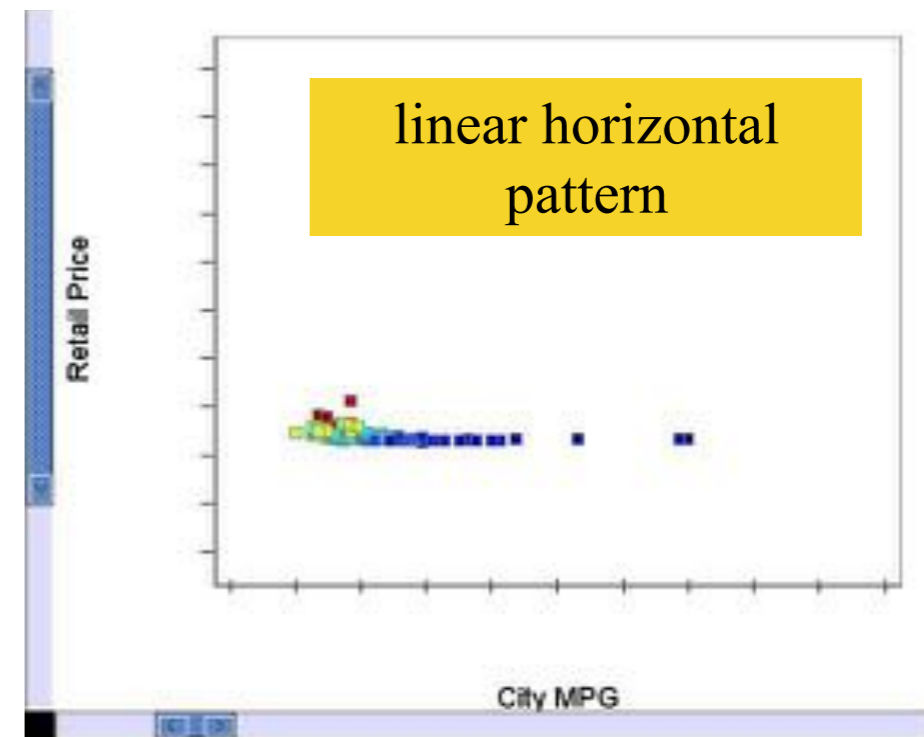
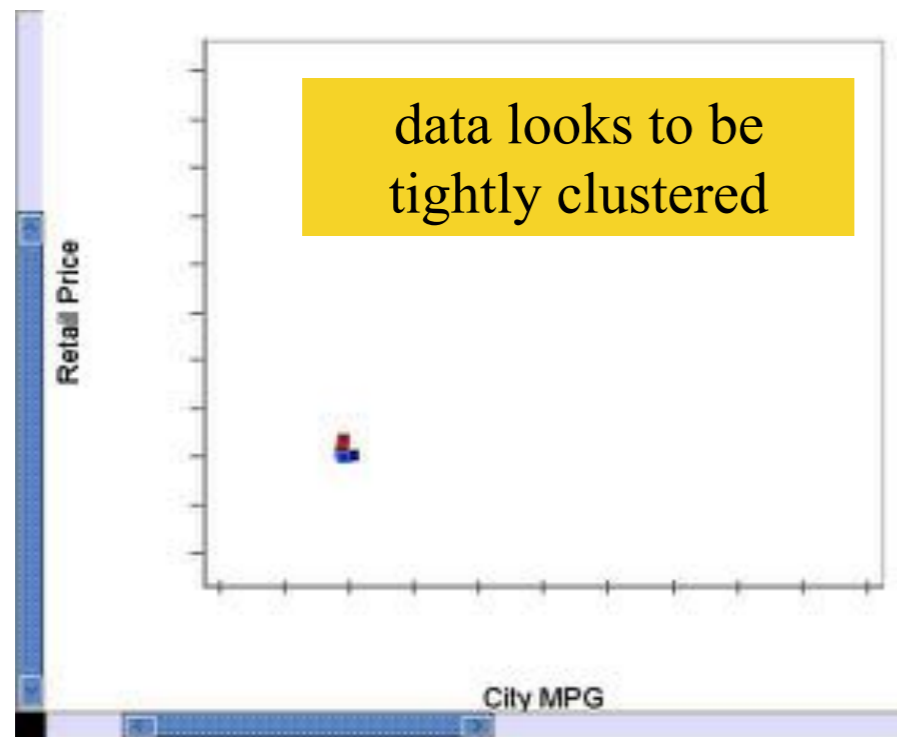
F. J. Anscombe (1973)

Statistic is not enough !

Data Vis is not enough !

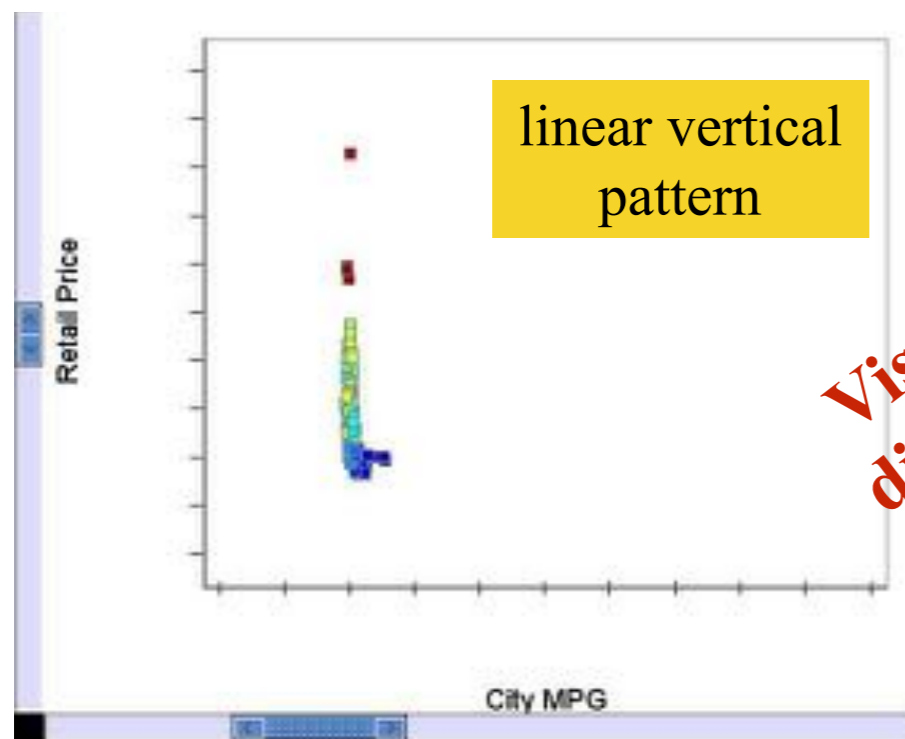
Why (data) visualization is important?

- What is the effect of the presentation of the data on the decision making process?
- Can the presentation of data impact the decision?
- Can we say which presentations are better or more influential than others?

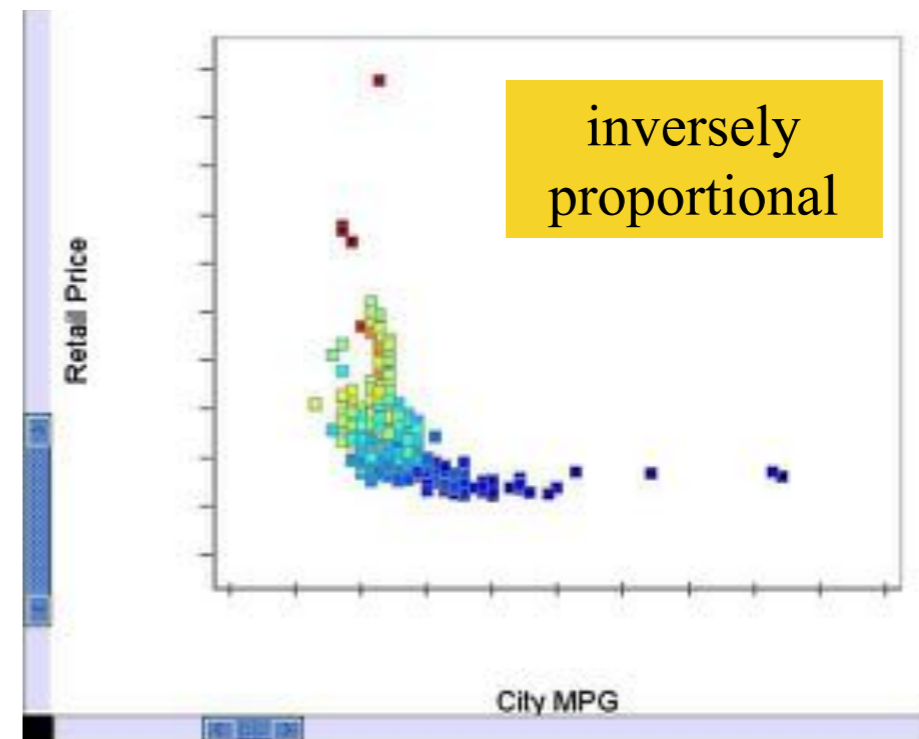


Why (data) visualization is important?

- What is the effect of the presentation of the data on the decision making process?
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Visualization can distort the "truth"



Why (data) visualization is important?

- What is the the role of **human preferences and training** in the visualization?

. Linda S. Elting, James M. Walker, Charles G. Martin, Scott B. Cantor, and Edward B. Rubenstein. “**Influence of Data Display Formats on Decisions to Stop Clinical Trials.**” British Medical Journal 318 (1999)

- Hypothetical clinical trial:

- Two treatments: 50 patients with conventional and 60 with investigational

- Two populations: 65 with good prognosis and 45 with bad prognosis

- Two outcomes for each treatment: Response (positive) vs Fail

- 34 clinicians

- **If a clinician sees that one treatment is better than the other, then he should stop the clinical treatment**

Why (data) visualization is important?

- What is the the role of **human preferences** and training in the visualization?

4 visualizations:

Table

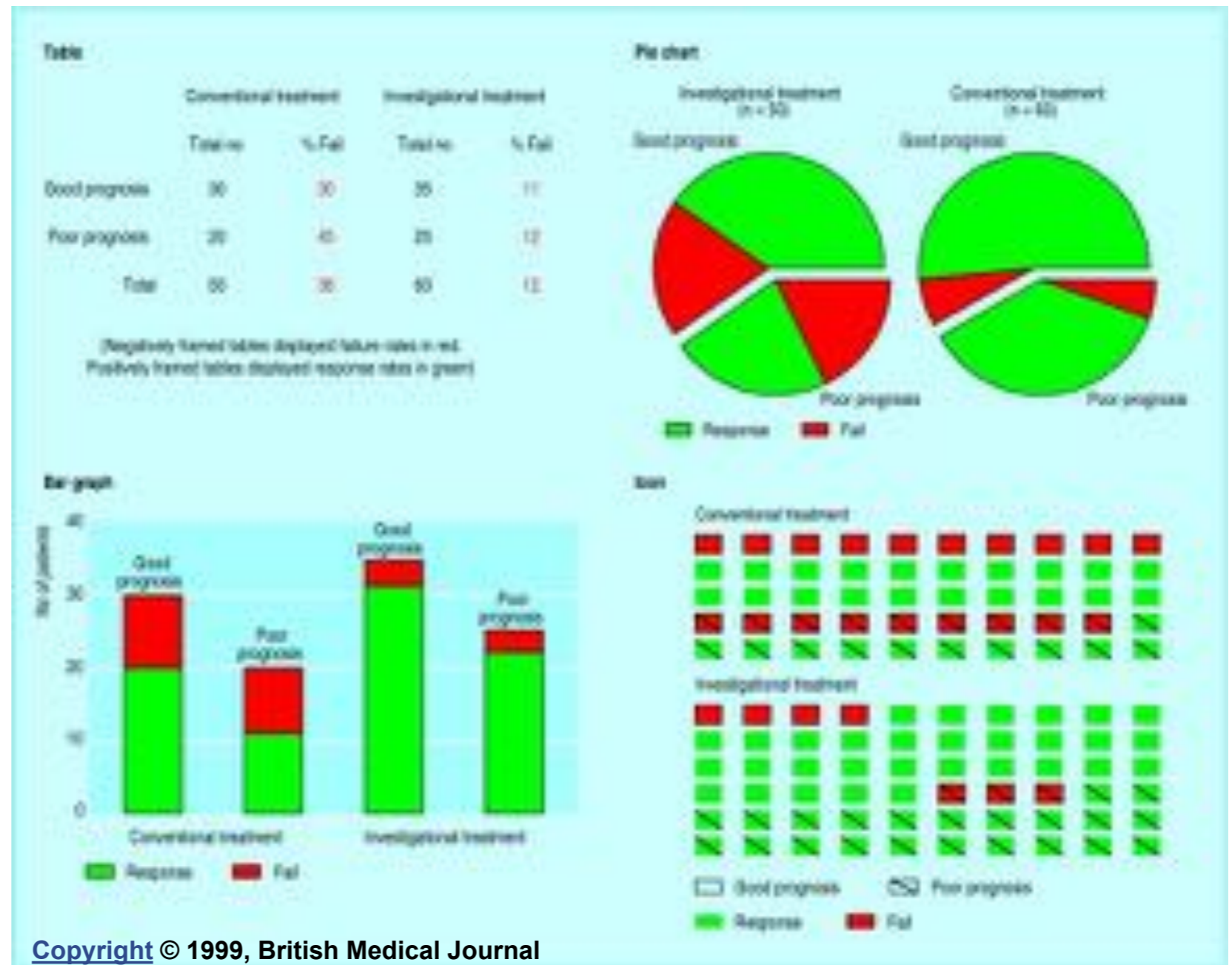
Pie Chart

Bar Graph

Icon

Green - Response

Red - Fail

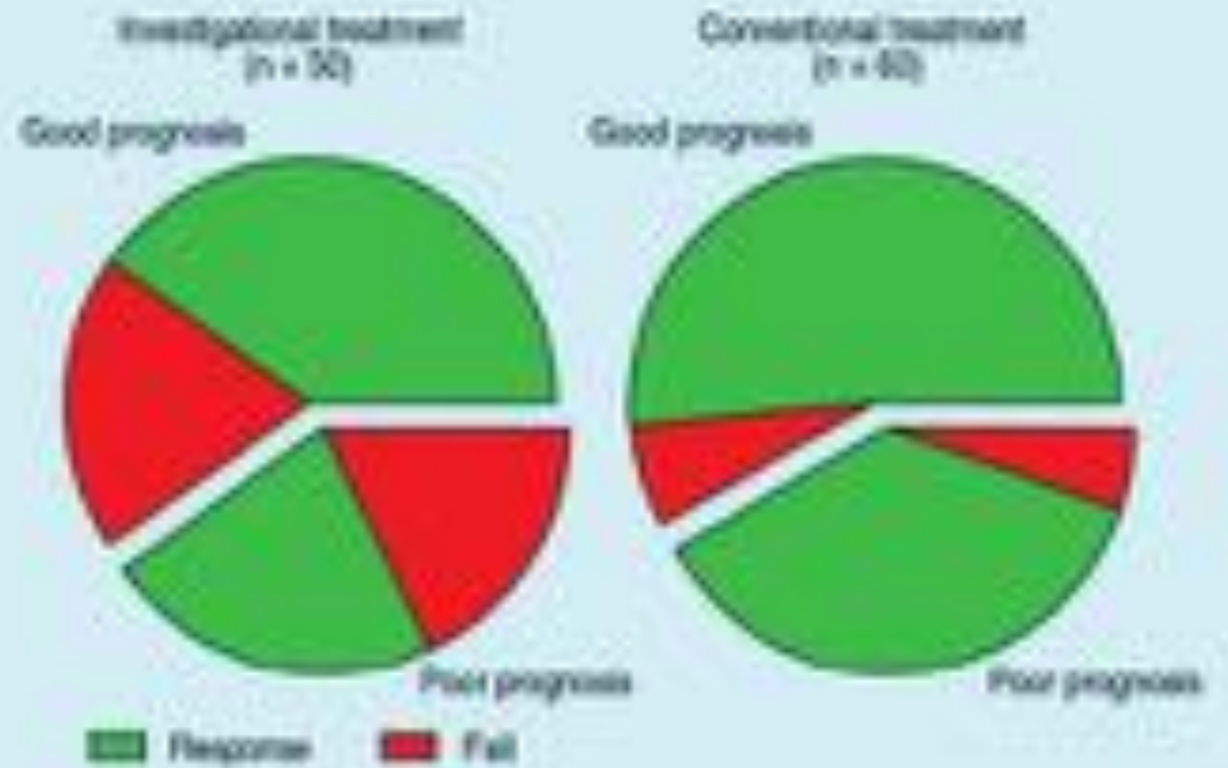


Table

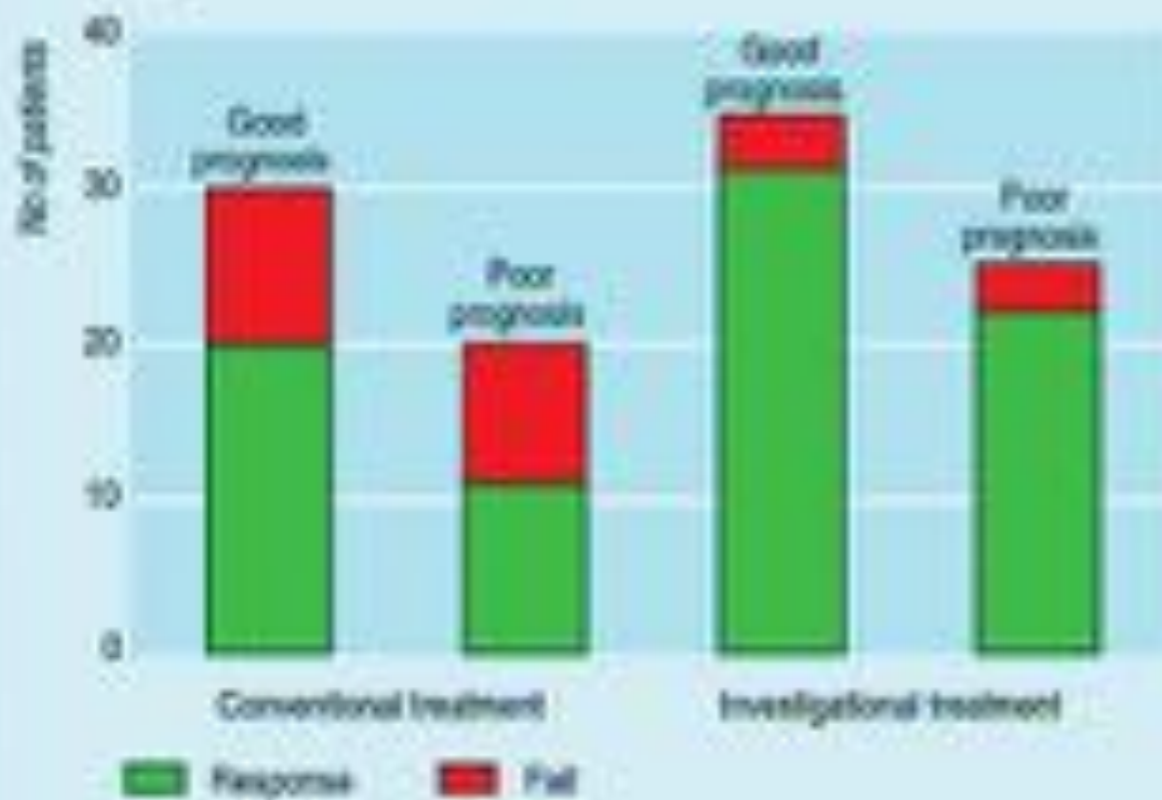
	Conventional treatment		Investigational treatment	
	Total no	% Fail	Total no	% Fail
Good prognosis	30	33	35	11
Poor prognosis	20	45	25	12
Total	50	38	60	12

(Negatively framed tables displayed failure rates in red.
Positively framed tables displayed response rates in green)

Pie chart



Bar graph



Icon



Why (data) visualization is important?

- What is the the role of **human preferences and training** in the visualization?
 - **PARTICIPANTS** were shown tables, pie charts, bar graphs, and icon displays containing hypothetical data from a clinical trial and were asked to decide whether to continue the trial or stop for an unplanned statistical analysis.
 - **MAIN MEASURE** : Percentage of accurate decisions with each type of display
 - **RESULTS:**
 - ◆ **More correct decisions were made with icon displays** (82%) than with tables (68%), pie charts (56%), and bar graphs (43%).
 - ◆ Most (21) clinicians preferred the table; Several were contemptuous of the icon display.

The visualization is key in presenting data but the user preferences are very involved

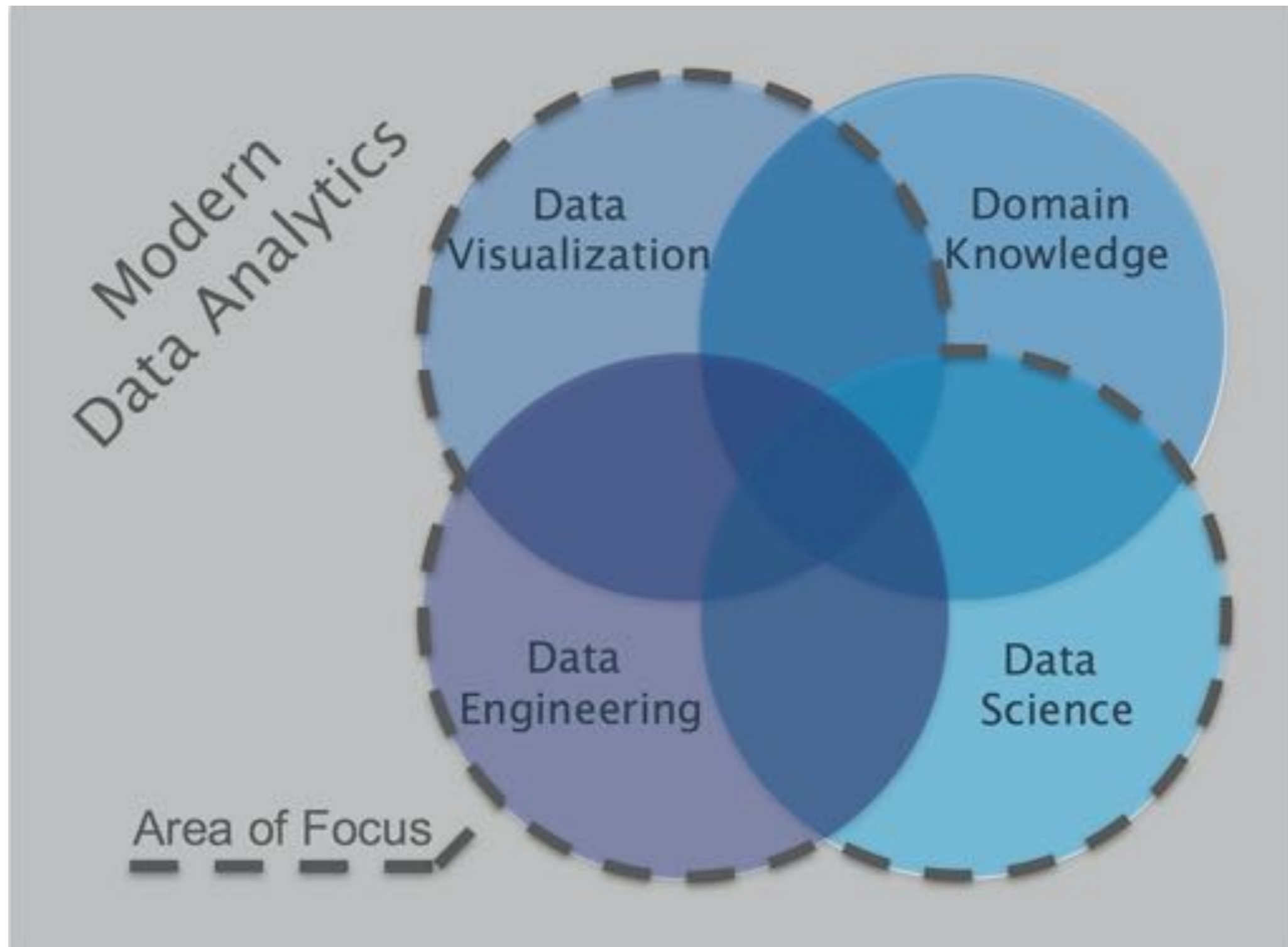
Why (data) visualization is important?

- **Nowadays**
 - **Generating a lot of data and information**
 - **Need to process such information**
 - **Need to communicate increasing levels of information**

Visualization is a **cornerstone of modern knowledge discovery tools**. Applications often include one or more visualizations to provide different views of data to describe some patterns or structures.

We need to communicate information to people in an efficient and effective manner.

Why (data) visualization is important?



Why the **study** of data visualization is important?

- Tamara Munzner, 2015

1.11

Why Are Most Designs Ineffective?

The most fundamental reason that vis design is a difficult enterprise is that the vast majority of the possibilities in the design space will be ineffective for any specific usage context. In some cases, a possible design is a poor match with the properties of the human perceptual and cognitive systems. In other cases, the design would be comprehensible by a human in some other setting, but it's a bad match with the intended task. Only a very small number of possibilities are in the set of reasonable choices, and of those only an even smaller fraction are excellent choices. Randomly choosing possibilities is a bad idea because the odds of finding a very good solution are very low.

Why the **study** of data visualization is important?

■ Tamara Munzner, 2015

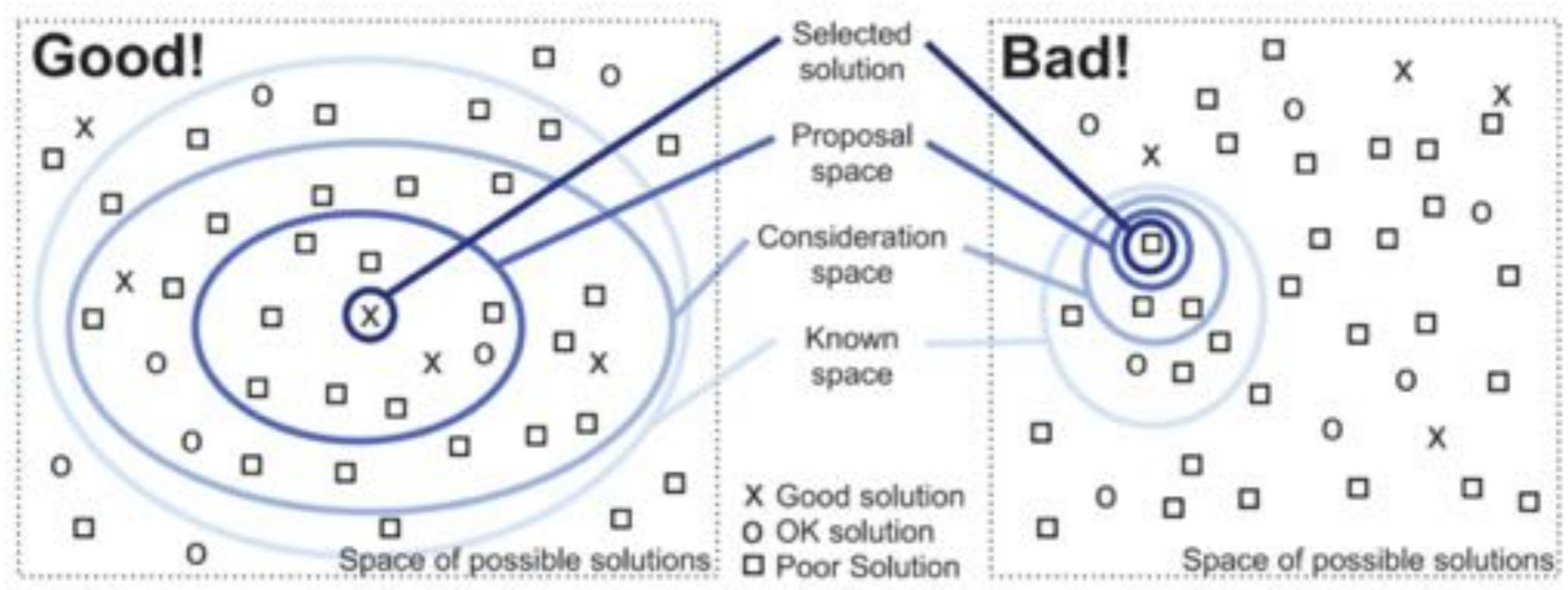


Figure 1.5. A search space metaphor for vis design.

When (data) visualization is important?

DATA

DATA VIS



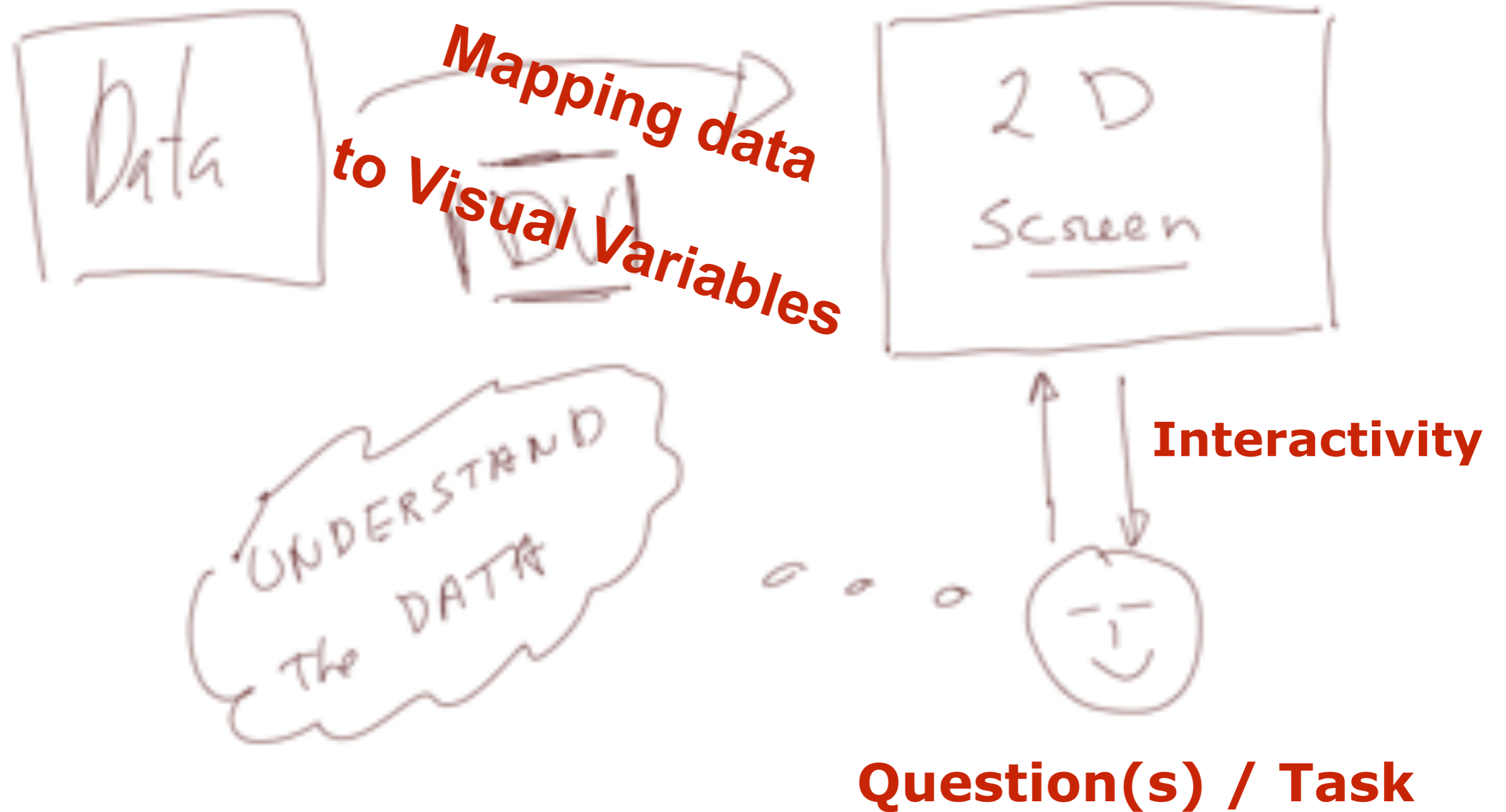
When (data) visualization is not important?

DATA



What is the core idea of Data Visualization?

What is the core idea of Interactive Data Visualization?



What is the core idea of Interactive Data Visualization?

- eight visual variables:

- ◆ position,

- ◆ shape,

- ◆ size,

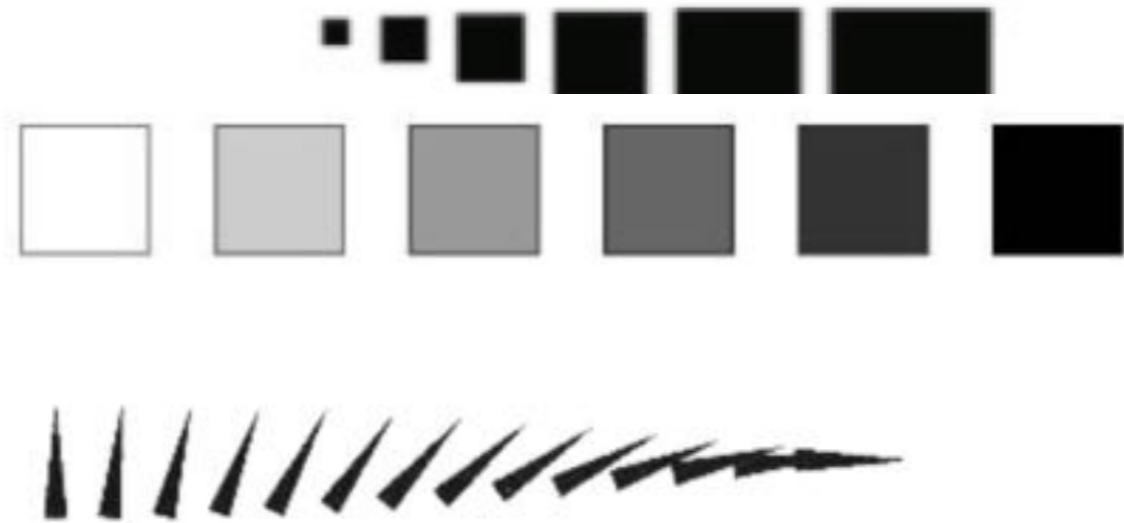
- ◆ brightness,

- ◆ color,

- ◆ orientation,

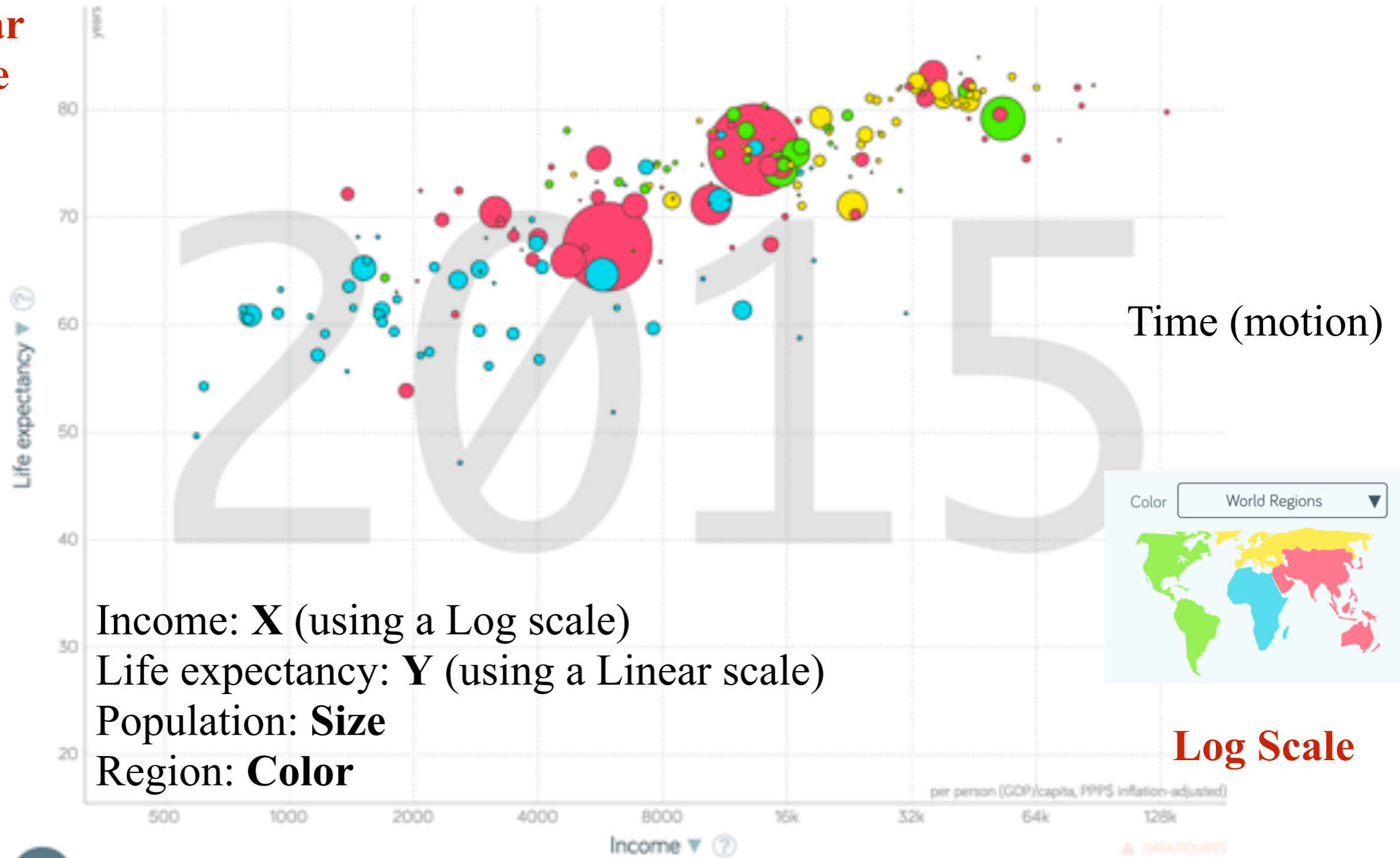
- ◆ texture,

- ◆ motion

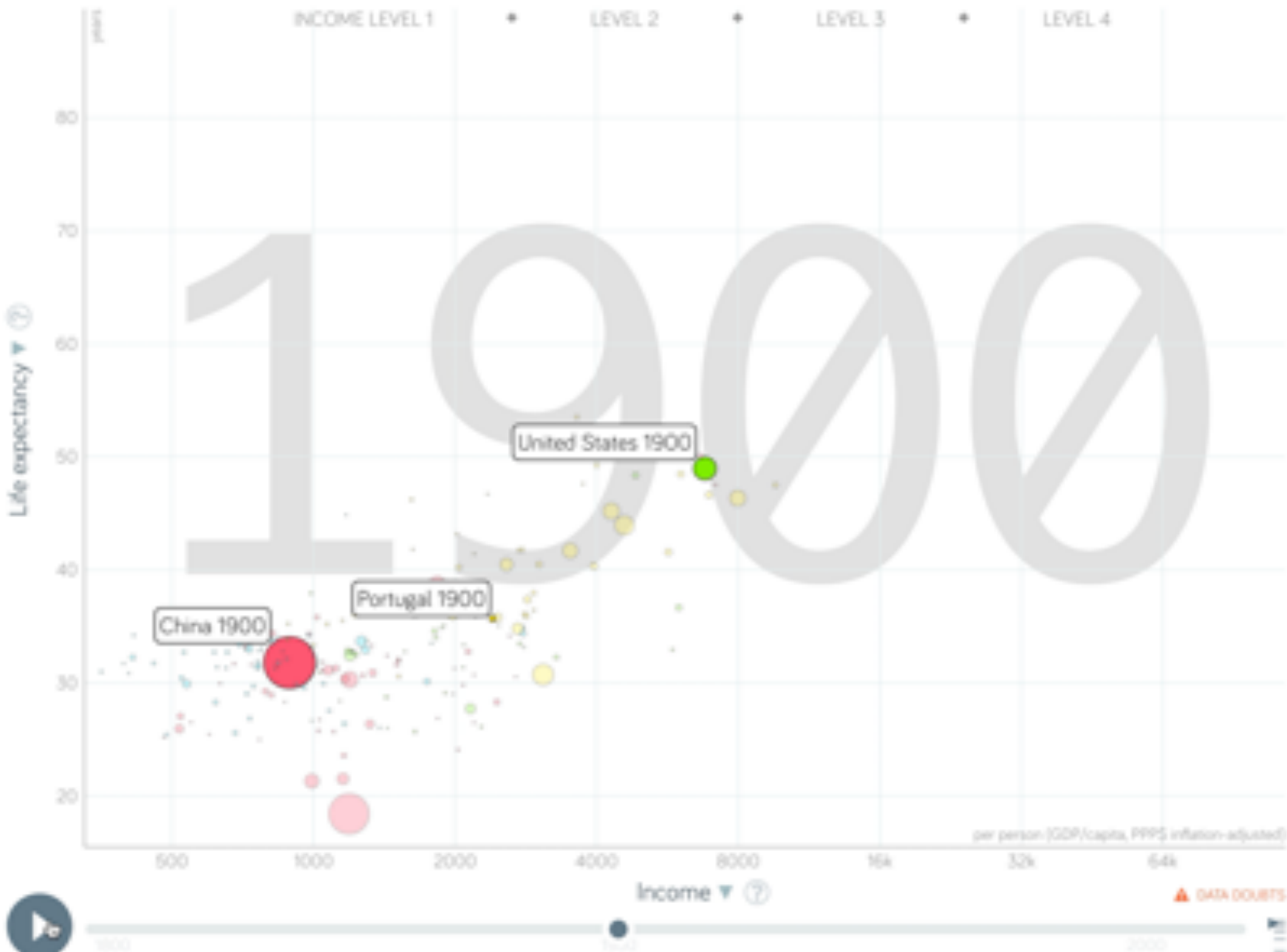


Eight visual variables

**Linear
Scale**



Hans Rosling



Color World Regions



Select Search...

- United States
- Portugal
- China
- Afghanistan
- Albania
- Algeria
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia
- Australia
- Austria
- Azerbaijan
- Bahamas

DESELECT

Size Population

Zoom

TOOLS LOCK OPTIONS EXPAND PRESENT

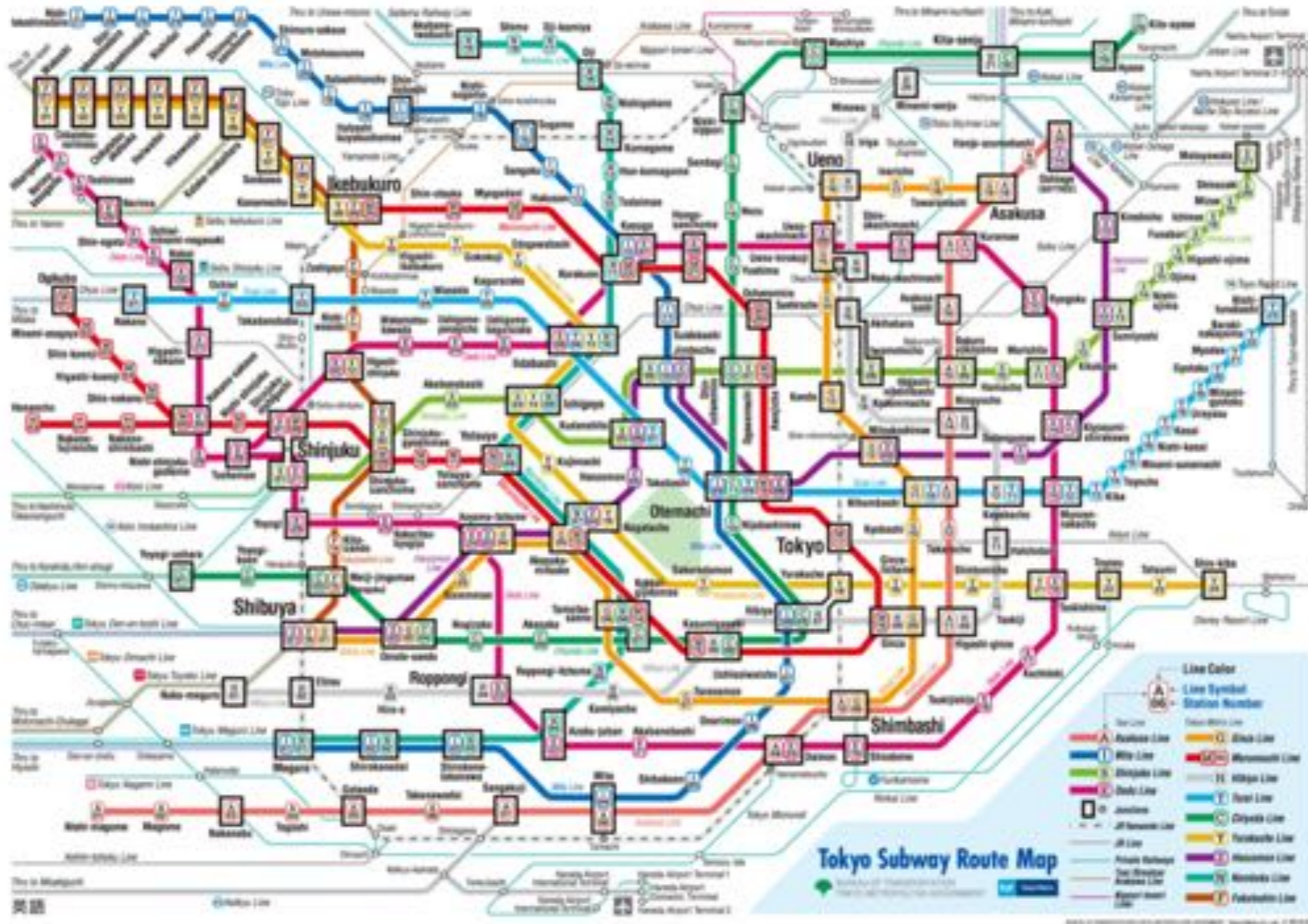
DATA DOUBTS

(Data) Visualization today

Visualization today

■ Qualitative versus Quantitative

Tokyo



Visualization today

■ Qualitative versus Quantitative

Paris



Visualization today

■ Qualitative versus Quantitative

Lisbon

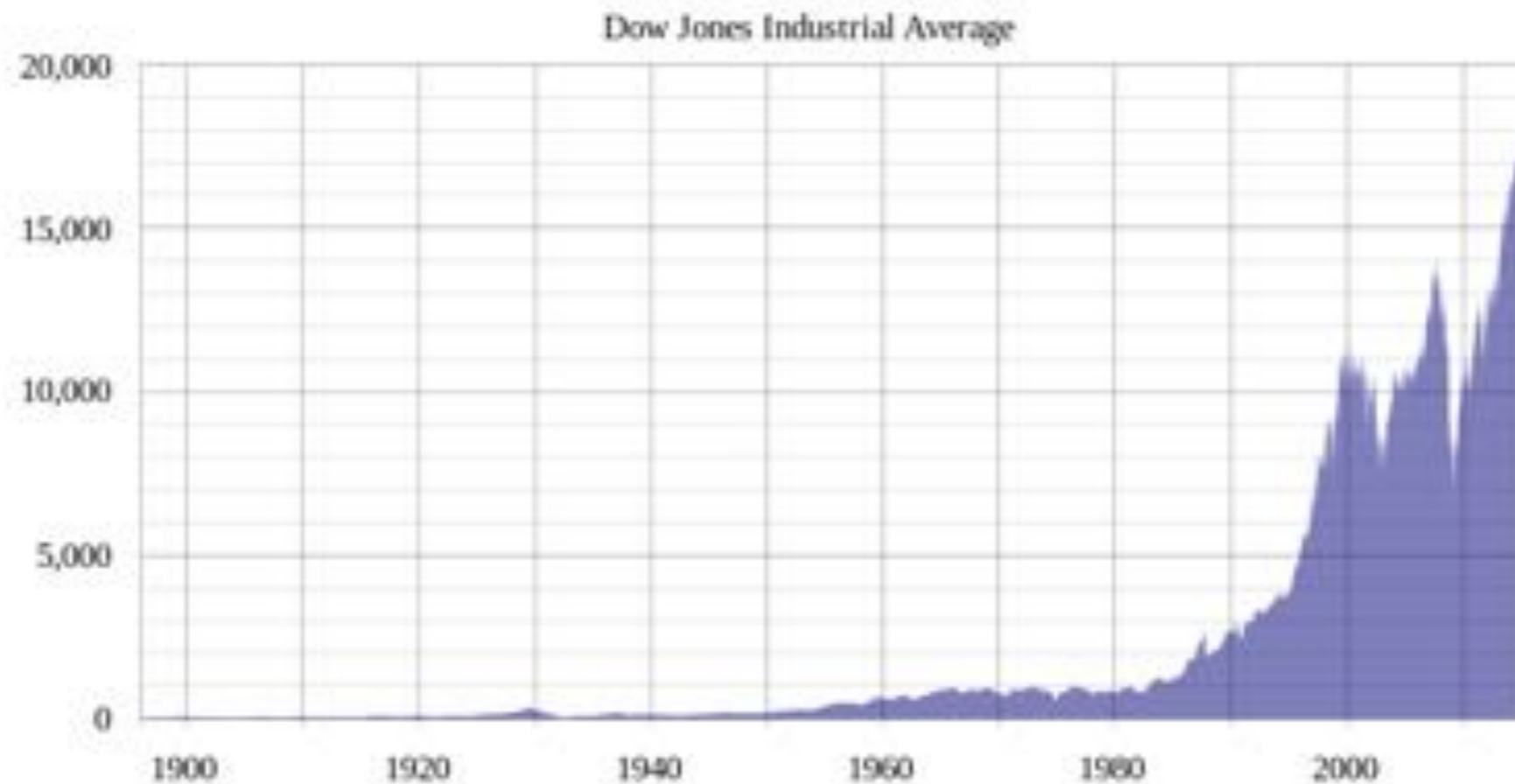


Visualization today

- Precision versus Imprecision

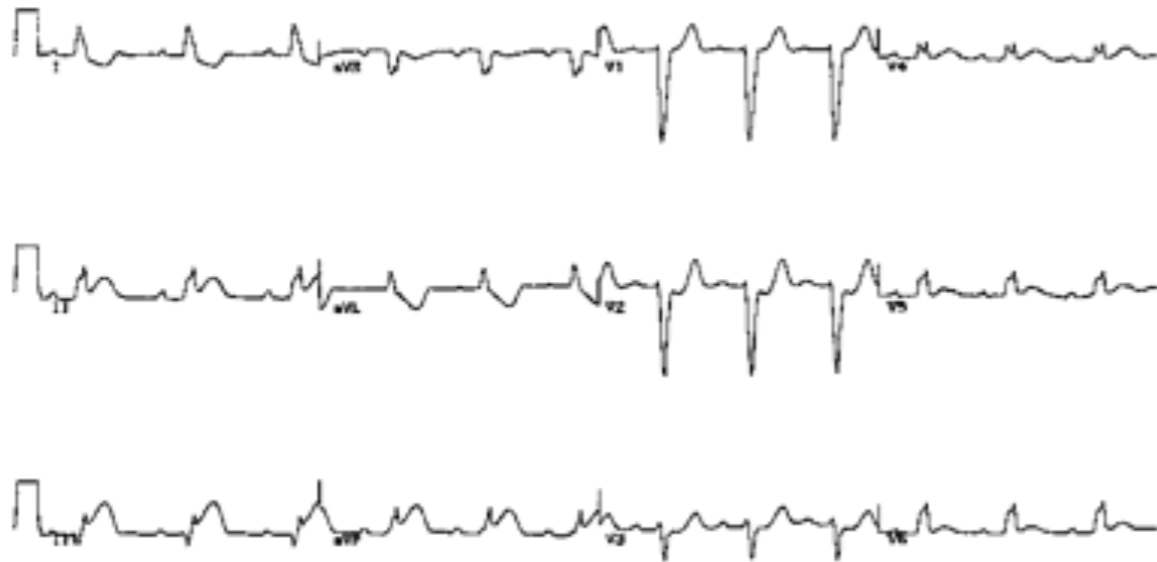
\$11,956,584,748,608.58

US National public debt at January 22, 2006



Visualization today

■ Precision versus Imprecision



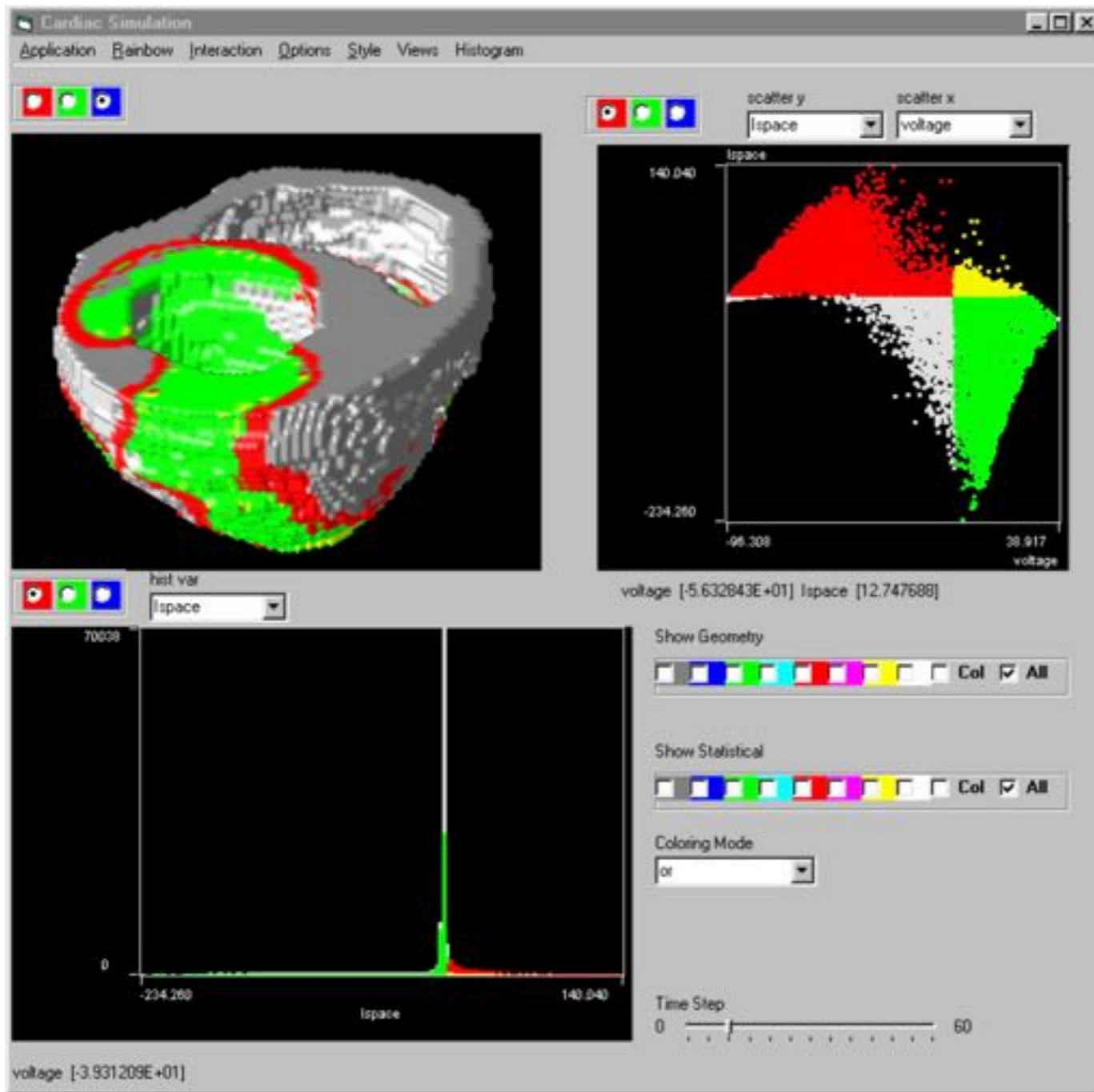
A 79 year old man with 5 hours of chest pain



A 53 year old man with Ischaemic Heart Disease

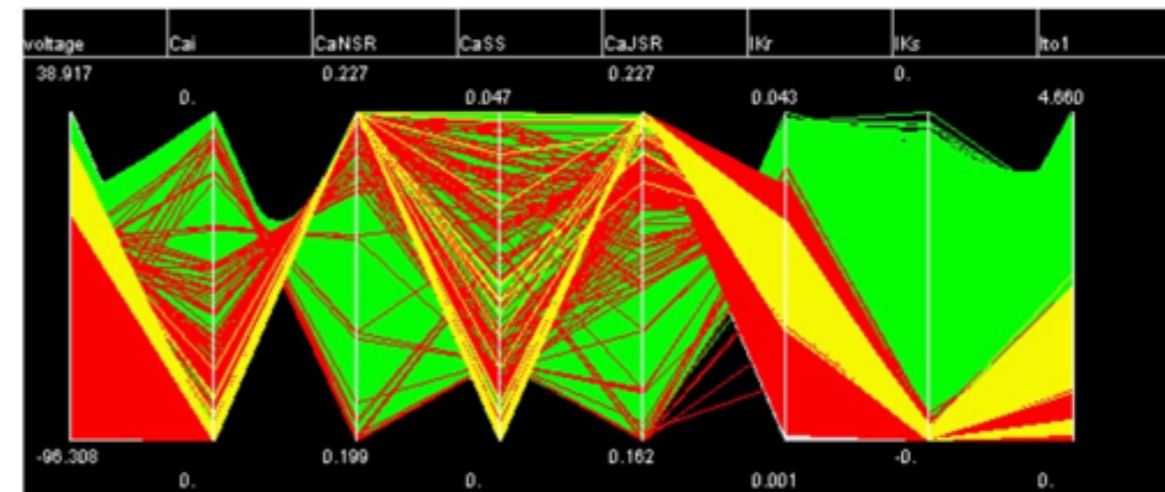
Visualization today

■ Single visualization versus Multiple visualization



Heart 3D Model
Additional parameters

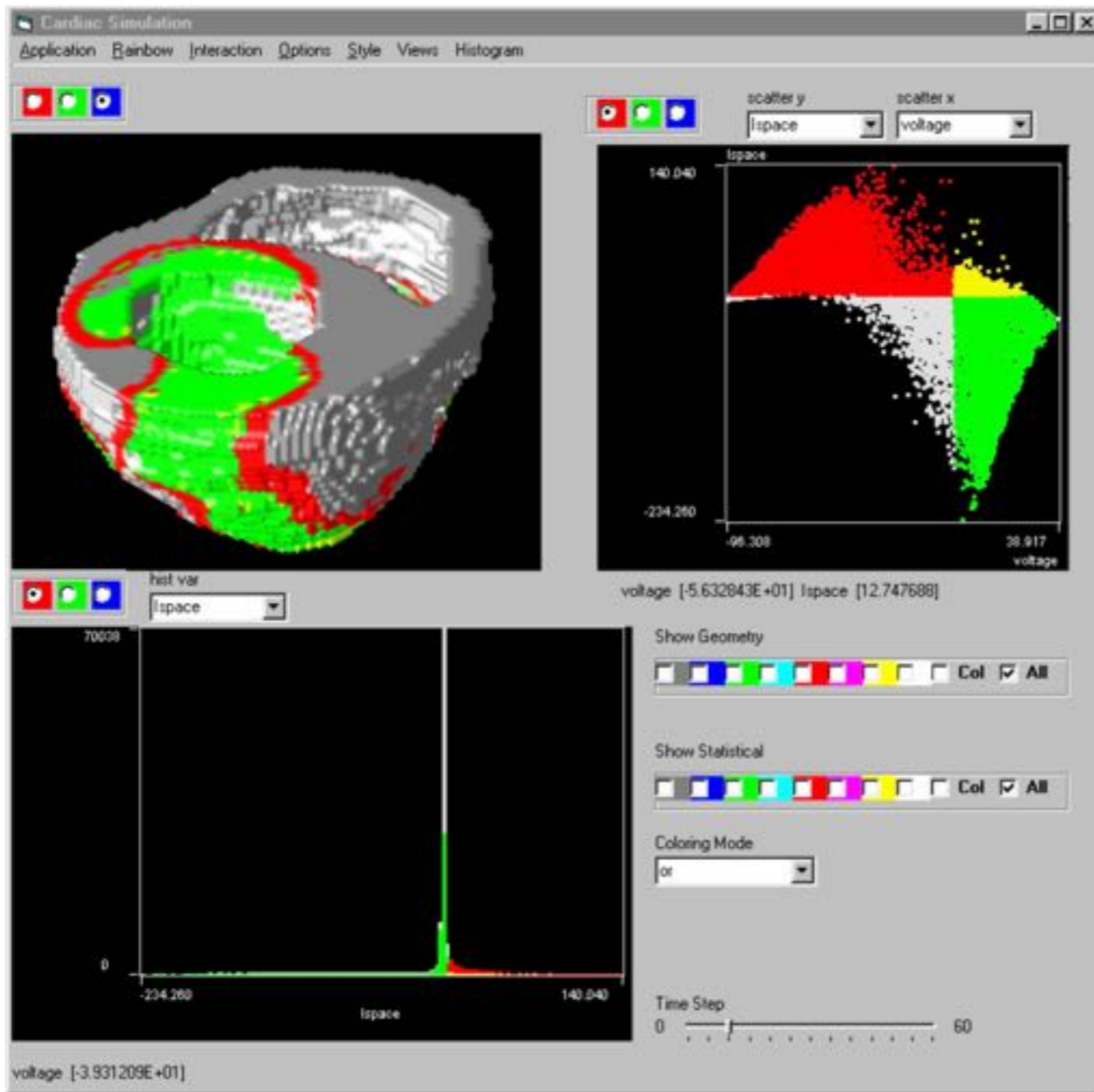
Linked parallel coordinates presentation



D. L. Gresh, B. E. Rogowitz, R. L. Winslow, D. F. Scollan, and C. K. Yung. "WEAVE: A System for Visually Linking 3D and Statistical Visualizations, Applied to Cardiac Simulation and Measurement Data."

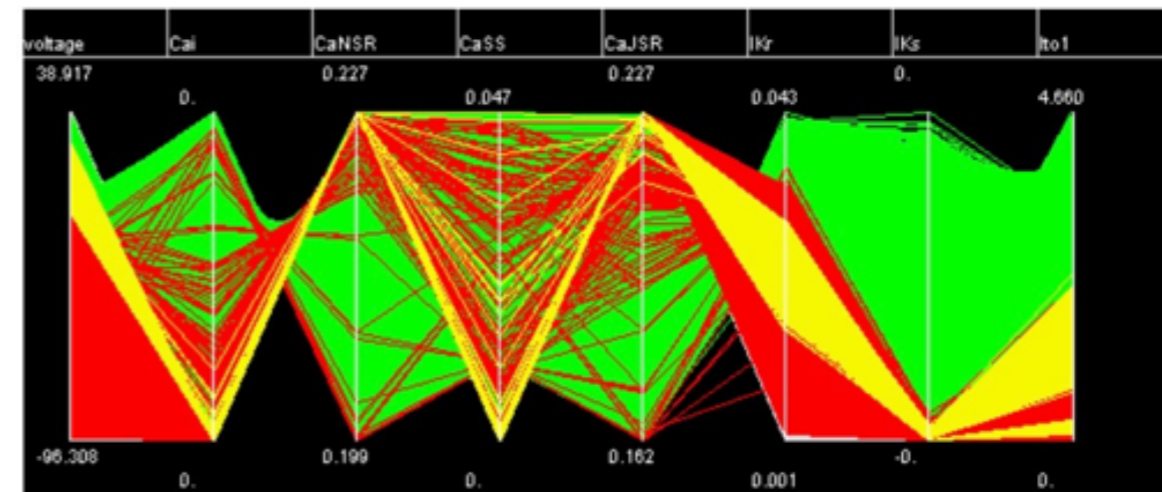
Visualization today

■ Static versus Interactive



In an **interactive** visualization the user can query the display and thus interact with the application display directly rather than menus

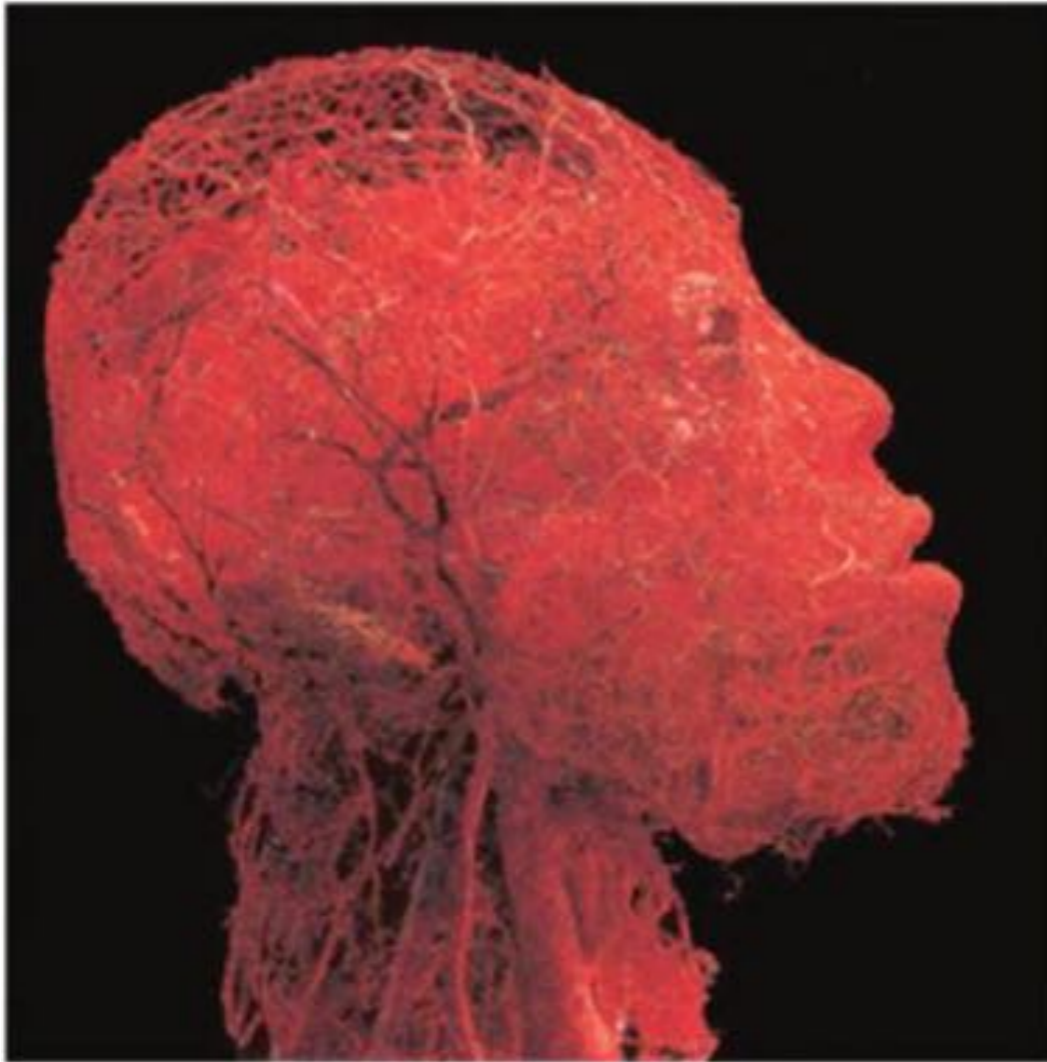
Linked parallel coordinates presentation



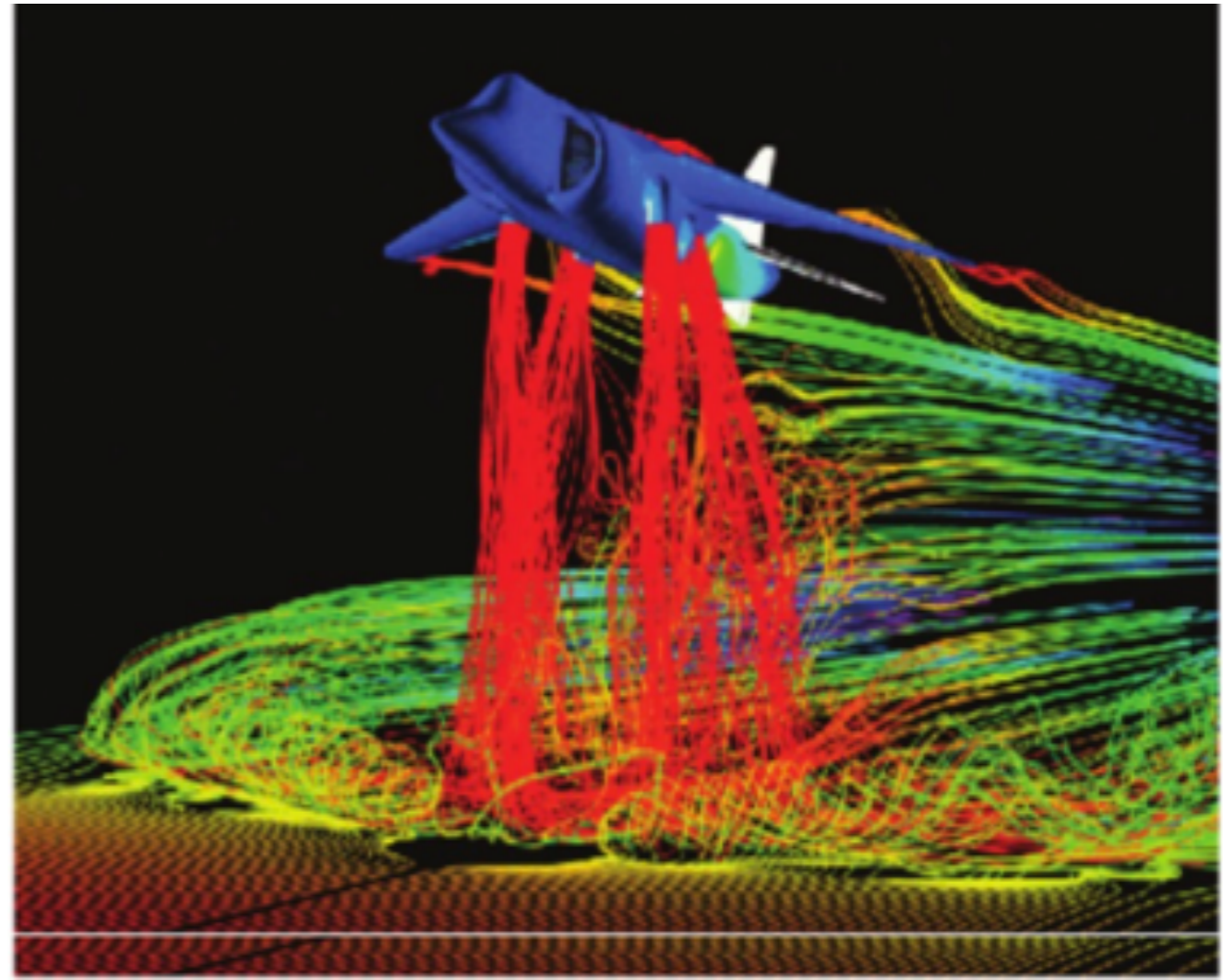
D. L. Gresh, B. E. Rogowitz, R. L. Winslow, D. F. Scollan, and C. K. Yung. "WEAVE: A System for Visually Linking 3D and Statistical Visualizations, Applied to Cardiac Simulation and Measurement Data."

Visualization today

- Abstraction versus “real images”



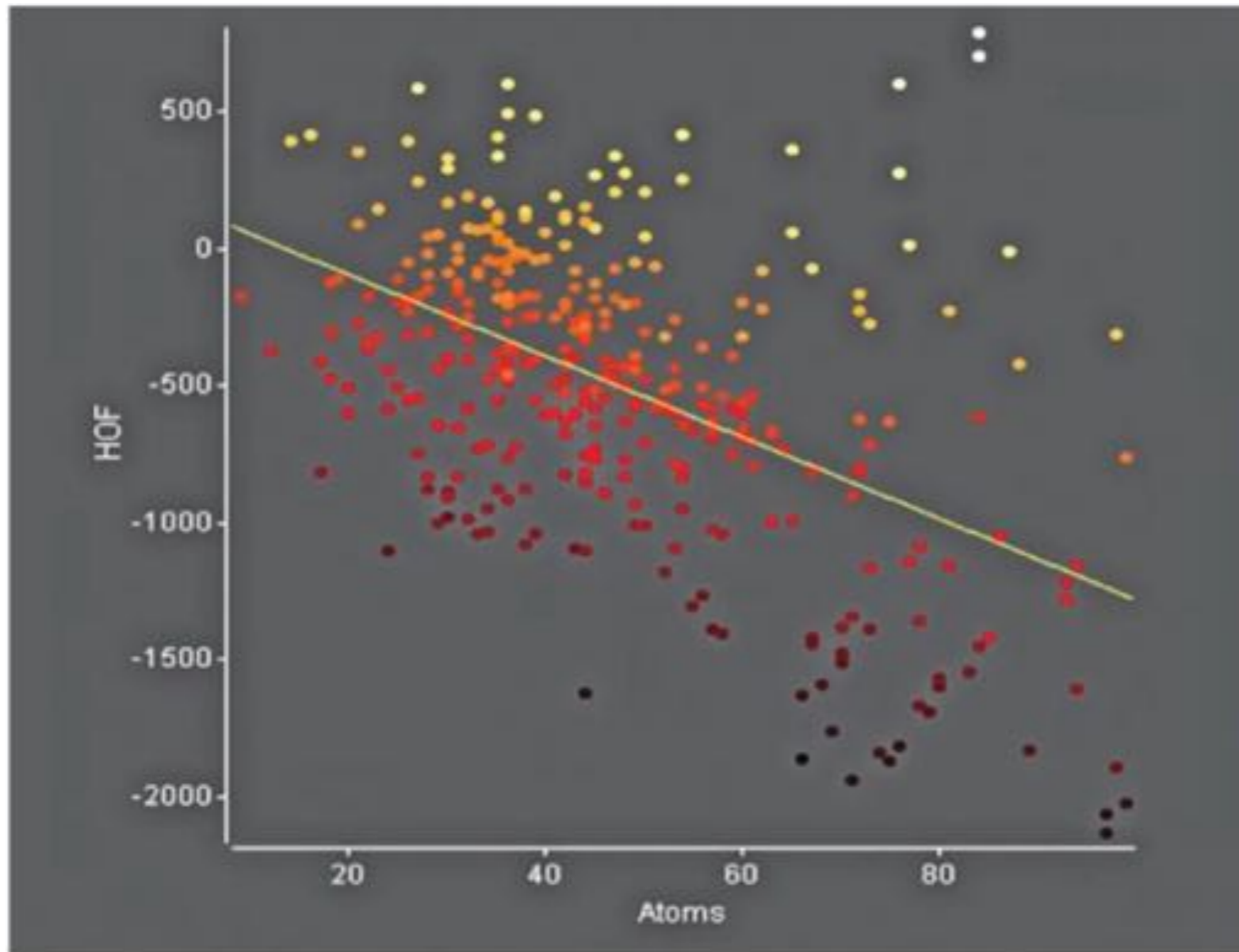
Blood vessel configuration of the head and Brain (<http://www.bodyworlds.com/>)



Simulation visualization of the air generated by a Harrier Jet (<http://quest.nasa.gov/aero/background/tools/>)

Visualization today

■ Abstraction versus “real images”



x -coordinate: number of atoms;
 y -coordinate: heat information;

$$y = mx + b; m = -12.5 \text{ and } b = 50$$

Color of each point: Gibbs energy

Visualization provides **visual representation of objects** that may include data, algorithms, results of computations, process and many other components of the application

The ability to provide rich descriptions of data is one of the strengths of visualization

Mechanism of action for yeast (image generated by UMass Lowell UVP Software)

Visualization today: IEEE - VIS

- IEEE - VIS conference is a major venue for visualization from 1987 !
 - IEEE Visual Analytics Science and Technology (VAST)
 - IEEE Information Visualization (InfoVis)
 - IEEE Scientific Visualization (SciVis)
- <http://www.aviz.fr/~bbach/vis25timeline/>



Revive 25 Years of Visualization
Research in the VIS25 timeline!

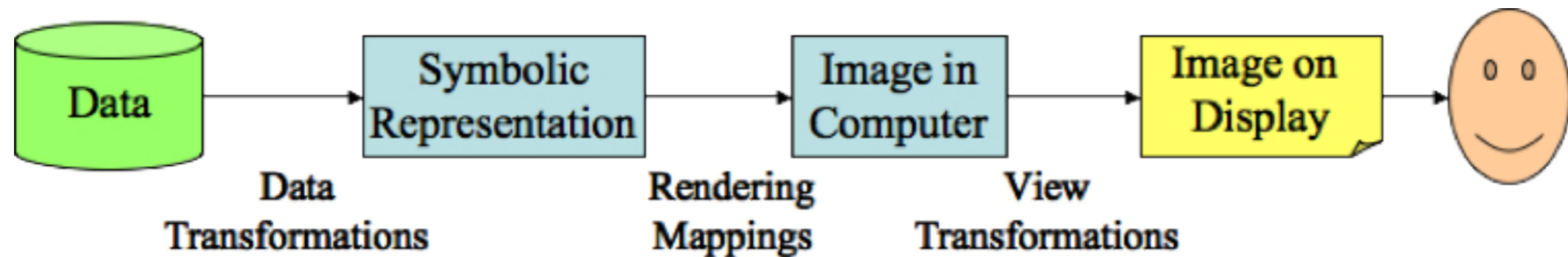
(Data) Visualization and other fields

Visualization and other fields

- **Visualization** emerges as a sub-field of Computer Graphics, and is now a new field that encompasses aspects from *human-computer interaction, perceptual psychology, databases, statistics, data mining*, and *computer graphics*, and others.
- *Computer graphics* focus on graphical objects and the organization (and implementation) of graphical primitives.
- Visualization is the application of graphics to **display data** by **mapping data to graphical primitives** and rendering the display.
- In Computer Graphics the visual realism is often one major concern. In Visualization the focus is on finding an **effective communication of information**.

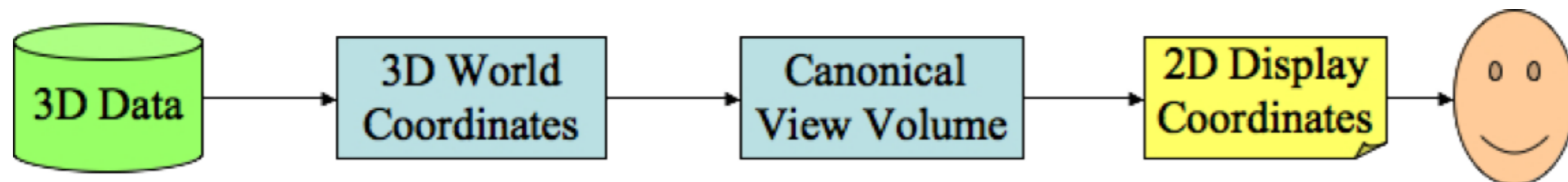
Visualization Process

- What is involved in the **Visualization** process?
 - Type of data available for display
 - Type of the information the Viewer hopes to extract from (exploration; confirm hypotheses) or convey with the display (present results)



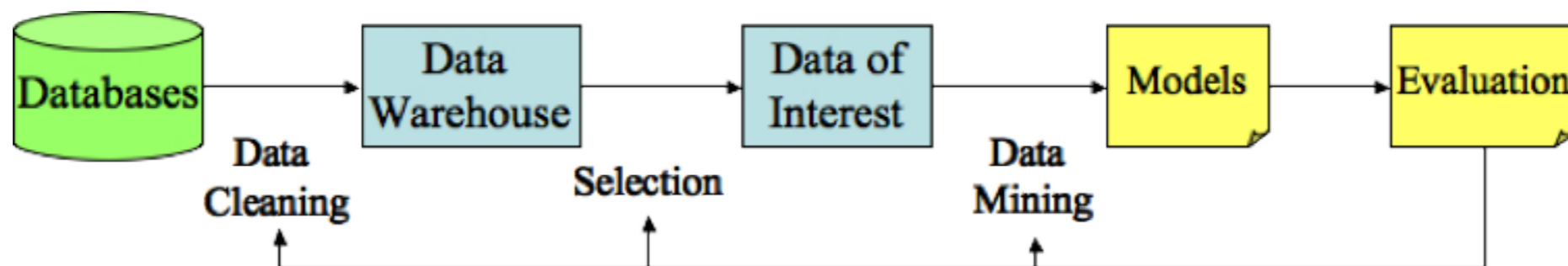
Visualization Process: **computer graphics pipeline**

- For computer graphics the stages are:
 - **Modeling: 3D model**
 - **Viewing: virtual camera**
 - **Clipping: bounds of the desired image**
 - **Hidden surface removal & Projection: mapping to a 2D system**
 - **Rendering: color, illumination, etc.**



Visualization Process: the **knowledge discovery** pipeline

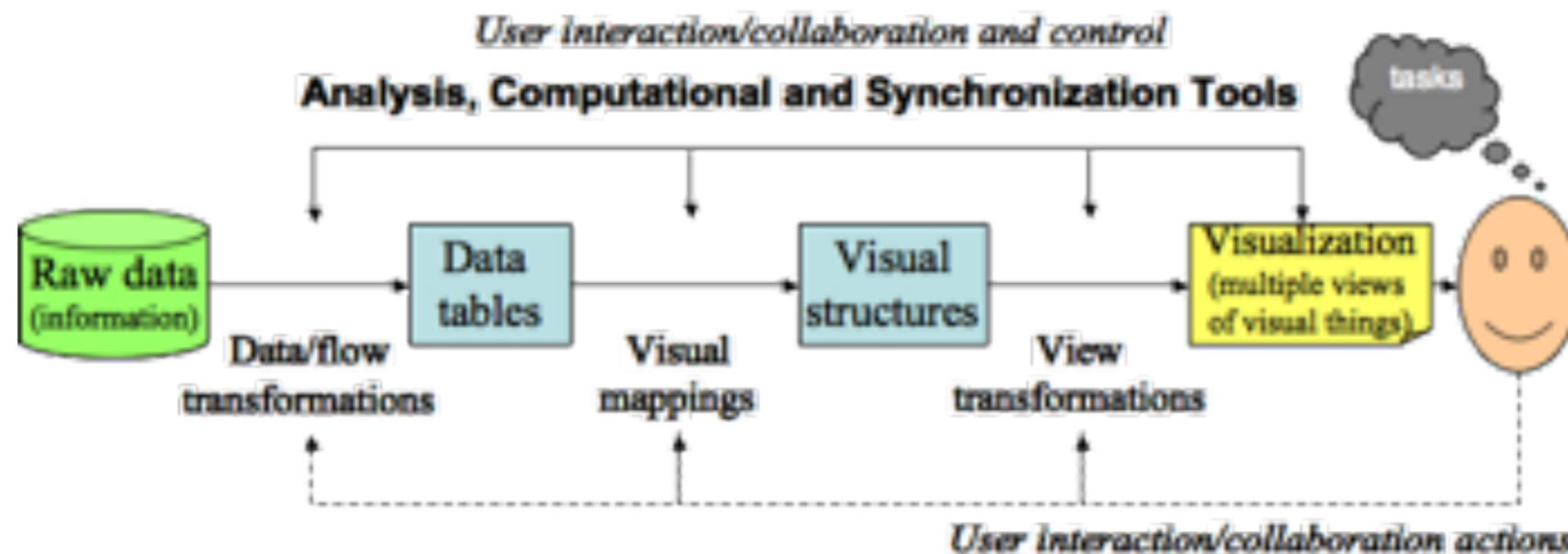
- For knowledge discovery the stages are:
 - Data
 - Data integration, cleaning, warehousing and selection
 - Data mining
 - Pattern evaluation
 - Rendering or visualization:



(*) Interactive visualization can be used at every step of KD pipeline

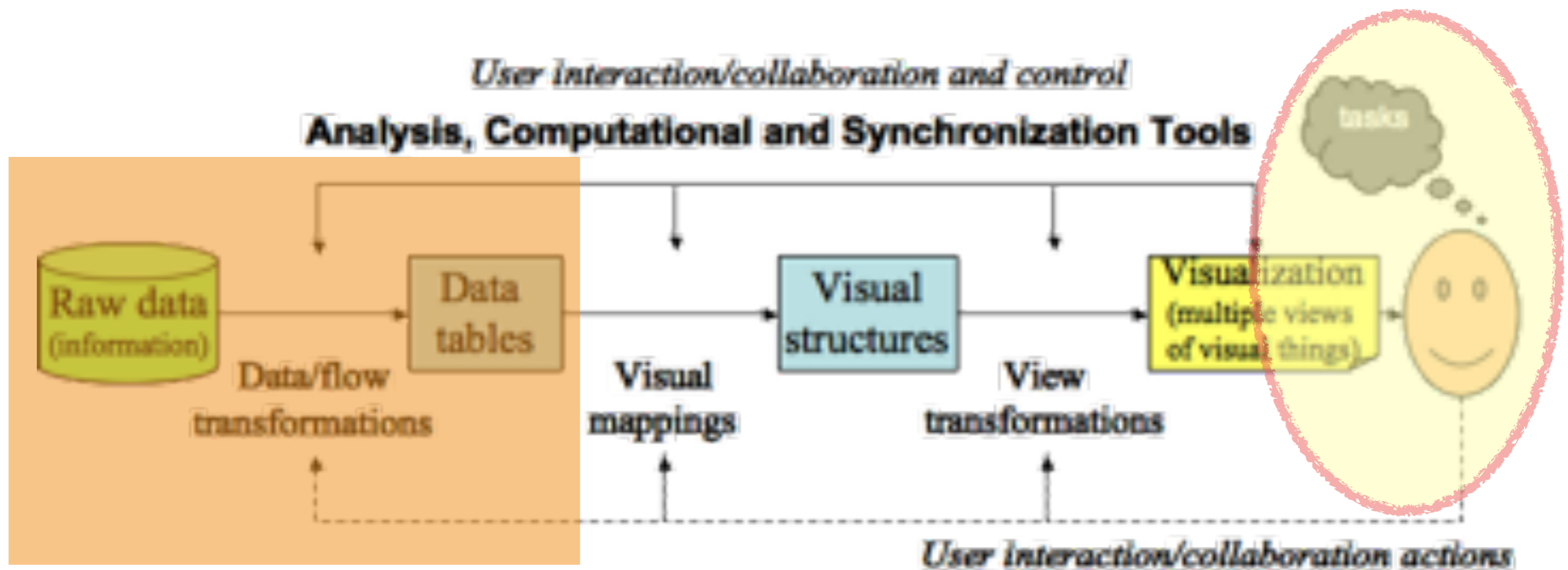
Visualization Process: Visualization pipeline

- For visualization the stages are:
 - Modeling: the data to be visualized
 - Data Selection: similar to clipping
 - **Data to visual mappings**: the heart of the visualization is mapping data values to graphical entities or their attributes; may involve scaling, shifting, filtering, interpolating, or subsampling.
 - Scene parameter setting: (ex: color mapping)
 - Rendering or generation of the visualization



Visualization Process: visualization pipeline

- What is involved in the **Visualization** process?
 - **Type of data available** for display
 - Type of the **information the Viewer hopes to extract from** (exploration; confirm hypotheses) or convey with the display (present results)



Further Reading and Summary



Q&A

Further Reading

■ Recommend Readings

- ◆ Interactive Data Visualization: Foundations, Techniques, and Applications, Matthew O. Ward et al, 2015, pages 1 - 38.

■ Supplemental readings:

- ◆ Cholera map's John Snow:
 - https://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak
- ◆ Napoleon
 - https://en.wikipedia.org/wiki/Charles_Joseph_Minard
- ◆ William Playfair:
 - https://en.wikipedia.org/wiki/William_Playfair
- ◆ Florence Nightingale:
 - https://pt.wikipedia.org/wiki/Florence_Nightingale
- ◆ Periodic table:
 - https://en.wikipedia.org/wiki/Periodic_table

Check - vis25timeline

What you should know

- **What is Visualization.**
 - ◆ grocking the data => take decisions
- **Data Visualization can be extremely powerful**
 - ◆ Uncover new patterns; confirm hypothesis;
- **Why Visualization is important.**
 - ◆ Stats not enough; communication needs; exploratory needs
- **Key aspects of today Visualizations.**
 - ◆ Interactions; visual abstractions; multiple (linked) visualizations.
- **The general steps of a Visualization Process**
 - ◆ Raw data -> data -> viz structures -> images -> **perception** + **feedback**
- **The role of Perception.**
 - ◆ The role and the importance of the user.

Further Reading and Summary



Q&A

Course Organization and Overview

Introduction to Data Visualization

What Is Visualization?
Relationship between Visualization and Other Fields.
The Visualization Process.
Data Foundations.
Human Perception and Information Processing.
Semiology of Graphical Symbols.
The Visual Variables.

Visualization Techniques

Visualization Techniques for Spatial Data
Visualization Techniques for Geospatial Data
Visualization Techniques for Time-Oriented Data
Visualization Techniques for Multivariate Data
Visualization Techniques for Trees, Graphs, and Networks
Text and Document Visualization

Interaction Concepts and Techniques

Interaction Operators, Operands and Spaces (screen, object, data, attributes)
Visualization Structure Space (Components of the Data Visualization)
Animating Transformations
Interaction Control
Designing Effective Visualizations
Comparing and Evaluating Visualization Techniques

Visualization Systems

Systems Based on Data Type
Systems Based on Analysis Type
Text Analysis and Visualization
Modern Integrated Visualization Systems
Toolkits

Research Directions in Visualization

Bibliography



Interactive Data Visualization: Foundations, Techniques, and Applications
Matthew O. Ward, Georges Grinstein, Daniel Keim
2015, 2nd Edition
ISBN: 9781482257373
ISBN (e-Book): 9781482257397



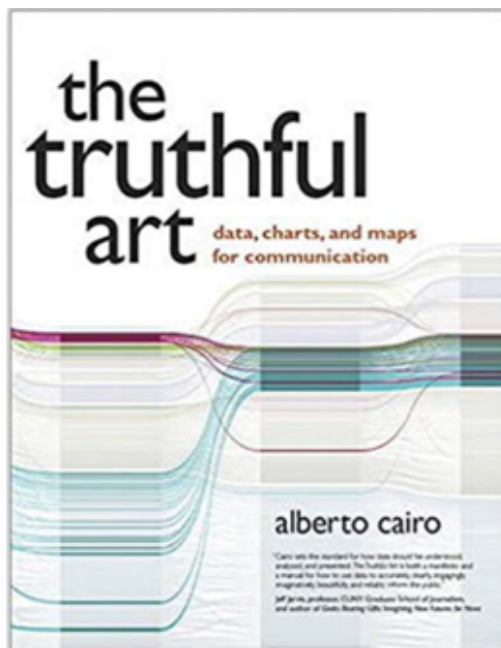
Visualization Analysis & Design
Tamara Munzner
2015,
ISBN: 9781466508910
ISBN (e-Book): 9781498707763

Bibliography



How Charts Lie: Getting Smarter about Visual Information

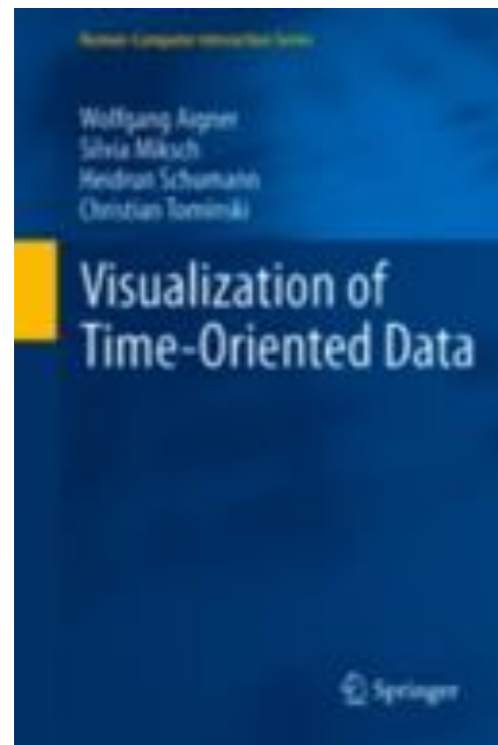
Alberto Cairo
2019



The Truthful Art: Data, Charts, and Maps for Communication (Voices That Matter)

Alberto Cairo
2016

Bibliography



Visualization of Time-Oriented Data

Wolfgang Aigner, Silvia Miksch Heidrun Schumann, Christian Tominski

Bibliography



<https://www.tableau.com/learn/training/20201>

Weekly routine

- Lectures - 1 x 2 h
- The lab sessions - 1 x 2 h
 - Demoing and Training
 - Project developing
- The recommended readings
- The recommended actions
- Meetings for student support if required

Evaluation rules

- Two mid-term written individual tests (25% each)
- One project (for team of two students), with several phases:
 - Specification
 - Paper (20%)
 - Code/implementation (30%)
 - (*) an oral discussion will be required to validate the project components
- Course approval requires the following minimal grades:
 - $(\text{mean}(\text{Test1}; \text{Test2}) \geq 10) \text{ AND } (\text{Test1} \geq 8) \text{ AND } (\text{Test2} \geq 8)$
 - $(\text{mean}(\text{Paper}; \text{Code\&Implementation}) \geq 10) \text{ AND}$
- Final exam may replace $\text{mean}(\text{Test1}; \text{Test2})$ if project is approved.

Web Site: <http://vid.ssdi.di.fct.unl.pt>

The screenshot shows the website header for 'IDV 19/20 Interactive Data Visualization' at the Faculty of Sciences and Technology, Universidade Nova de Lisboa. The header includes the FCT logo and navigation links for 'News / Home /'. A sidebar on the left contains a menu with items: Home, News, Information, Resources, Summaries, Training, and Evaluation. The main content area features a description of the course as a 6 ECTS unit, its provision by the Department of Informatics, and a notice about a news update from March 5th, 2020. It also includes a list of recommended links for first-time visitors and a closing message from the author, João Moura Pires.

IDV 19/20
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Interactive Data Visualization (IDV) is a 6 ECTS curricular unit of the set of specialization units offered to the students of 4th or 5th year of Mestrado Integrado em Engenharia Informática (MIEI) . Interactive Data Visualization presents the theoretical basis and practices for the design, use and evaluation of modern systems for Interactive Data Visualization.

This course is provided by Departamento de Informática (DI) da Faculdade de Ciências e Tecnologia (ECT) da Universidade Nova de Lisboa (UNL).

See the [News!](#) (**last update: March 5th 2020**) - IMPORTANT INFORMATION

If it is your first time visit on this site, I suggest you to take a look on:

- [News](#)
- [Information](#)
- [Information / Evaluation Rules](#)

I hope we will have a nice semester !

[João Moura Pires](#) [STARResearch.NET](#) [Contact Me](#)

VID - Visualização Interactiva de Dados

Web Site: News

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[Notice](#)
[March 2020](#)
[VID RSS Feed](#)

[IMPORTANT]: On March 6th, Friday we have the first lecture and Lab sessions
01 11 03 11 20 à 16:56 Filed in: [Notice](#)

This first lecture will start at 16:10 (127 / Ed. II) and will be a full lecture.

The Lab sessions will also start this week !!!
The first one will be at 14:10 - Lab 114 (before the lecture)
The second one will be at 18:10 (lab 114 (after the lecture)

Bring your own headphones !

Visualization and Data Science
01 11 03 11 20 à 16:38 Filed in: [Notice](#)

(Interactive Data) Visualization is a major component of Data Science. In the Columbia's Introduction to Data Science the student have different backgrounds. This image shows the students skills according 8 axes of competencies. See [more here](#).

The Stars of Data Science

Students in Columbia's Introduction to Data Science course come from across the academic spectrum. Their skills are presented here in star charts with spokes representing their skill levels* across the data science skillset: **S**, statistics, mathematics, communication, data visualization, machine learning, computer science, and data wrangling. In addition to hovering in the center, the star chart of the overall class mean underlies each academic domain, so you can see students from each academic domain relative to the rest of the class. How would you compose your own intergalactic data science team?

*Skills were assessed by a survey written and administered by a subset of students in the class.

VID - Visualização Interactiva de Dados

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Interactive Data Visualisation (IDV) is a 6 ECTS curricular unit of the set of specialization units offered to the students of 4th or 5th year of [Mestrado Integrado em Engenharia Informática](#) (MIEI), and to students of [Mestrado em Análise e Engenharia de Big Data](#) (MAEDBD). Interactive Data Visualization presents the theoretical basis and practices for the design, use and evaluation of modern systems for Interactive Data Visualisation.

This course is provided by [Departamento de Informática](#) (DI) da [Faculdade de Ciências e Tecnologia](#) (FCT) da [Universidade Nova de Lisboa](#) (UNL).

Objectives:

Knowledge:

- What is Information Visualization, Data Visualisation (DV) and the different purposes of DV.
- The role of interactivity in DV and the general interaction patterns.
- The concept of Visual Variable and the practical consequence in the design of Interactive Data Visualization (IDV).
- The classification of data for DV purposes and the impact on IDV.
- For each type of data the most relevant available techniques.
- Due to its wide applicability, some deep understanding on Visualization Techniques for multivariate Data time oriented data and Geospatial Data.
- The main components of general IDV systems and the principal characteristics required on modern IDV systems.
- The available approaches to Compare and Evaluate Visualization Techniques and Systems.
- The actual trends in IDV and their role in more general systems and applications.

Application:

- Choose the visual variables and visualization techniques for a given data set and purposes.
- Use a given an existing IDV system to explore one or more data sets.
- Based on existing frameworks and platforms, design and build an IDV system appropriate for a class of data sets and a class of exploration and visualization tasks.
- Setup an experimental environment to evaluate a DV technique. Analyze the data gathered in the experimentation.

Soft-Skills:

- Understand the multidisciplinary nature of the area and the relationship with other areas.
- Explore the experimental nature for design IDV systems.

Prerequisites:
None

Teacher
Prof. João Moura Pires (jmp@fct.unl.pt) at office P3/2 and Tel: 10746.

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Interactive Data Visualisation (IDV) is a 6 ECTS curricular unit of the set of specialization units offered to the students of 4th or 5th year of [Mestrado Integrado em Engenharia Informática \(MIEI\)](#), and to students of [Mestrado em Análise e Engenharia de Big Data \(MAEDBD\)](#). Interactive Data Visualization presents the theoretical basis and practices for the design, use and evaluation of modern systems for Interactive Data Visualisation.

This course is provided by [Departamento de Informática \(DI\)](#) da [Faculdade de Ciências e Tecnologia \(FCT\)](#) da [Universidade Nova de Lisboa \(UNL\)](#).

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Hoje Março de 2020 Imprimir **Semana** **Mês** **Agenda**

Segunda	Terça	Quarta	Quinta	Sexta	Sábado	Domingo
24	25	26	27	28	29	1 Mar.
2	3	4	5	6	7	8
				14:00 VID - P2 16:00 VID - T 18:00 VID - P1		
9	10	11	12	13	14	15
				14:00 VID - P2 16:00 VID - T 18:00 VID - P1		
16	17	18	19	20	21	22
				14:00 VID - P2 16:00 VID - T 18:00 VID - P1		
23	24	25	26	27	28	29
				14:00 VID - P2 16:00 VID - T 18:00 VID - P1		

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Hoje Sexta-feira, 3 de abril ▾

Imprimir [Semana](#) [Mês](#) [Agenda ▾](#)

Sexta-feira, 3 de abril

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Sexta-feira, 17 de abril

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Sexta-feira, 24 de abril

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Segunda-feira, 27 de abril

18:00 VID - Test 1

Terça-feira, 28 de abril

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Sexta-feira, 8 de maio

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Sexta-feira, 15 de maio

14:00 VID - P2

16:00 VID - T

18:00 VID - P1

Sexta-feira, 22 de maio

14:00 VID - P2

16:00 VID - T

18:00 VID - P1



Web Site: Resources / Lectures



The screenshot shows a website for 'IDV 19/20 Interactive Data Visualization'. The header includes the course title and the logo of the Faculty of Sciences and Technology at the University of Lisbon. A navigation menu on the left lists various sections, with 'Resources' selected and 'Lectures' highlighted with a red circle. The main content area displays a link to 'IDV-01-COURSE OVERVIEW [PDF]' and a brief description of the course content. The footer contains contact information for João Moura Pires, STA@research.NET, and a 'Contact Me' link.

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Material used by the teacher during the lectures.

[IDV-01-COURSE OVERVIEW \[PDF\]](#)
What we mean by "Interactive Data Visualization"? What is Visualization? Why Visualization is important? Early Visualizations; Visualization today; Visualization and other fields. Visualization Process; The role of Perception. Course Organization and Overview: Syllabus; Bibliography; Evaluation rules; important dates, etc

[João Moura Pires](#) [STA@research.NET](#) [Contact Me](#)

Web Site: Resources / Papers

The screenshot shows the website for 'IDV 19/20 Interactive Data Visualization' at the Faculty of Sciences and Technology, Universidade Nova de Lisboa. The page features a navigation menu on the left with 'Papers' highlighted in red. The main content area lists several recommended papers, each with a title and author information.

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Recommended papers.
Some suggested by the students

[POLARIS: A SYSTEM FOR QUERY, ANALYSIS, AND VISUALIZATION OF MULTIDIMENSIONAL DATABASES](#)
By Chris Stolte, Diane Tang, and Pat Hanrahan

[A FEATURE-INTEGRATION THEORY OF ATTENTION](#)
By Annem. Treisman and Garrygelade.

[VISUAL SEARCH AND ATTENTION: A SIGNAL DETECTION THEORY APPROACH](#)
By Preeti Verghese

[THE STRUCTURE OF THE INFORMATION VISUALIZATION DESIGN SPACE](#)
By Stuart K. Card and Jock Mackinlay

[AN OPERATOR INTERACTION FRAMEWORK FOR VISUALIZATION SYSTEMS](#)
By Ed Hual-hsin Chi, John T. Riedl

[TOUR THROUGH THE VISUALIZATION ZOO](#)
A survey of powerful visualization techniques, from the obvious to the obscure, by Jeffrey Heer, Michael Bostock, and Vadim Ogievetsky

[TREE VISUALIZATION WITH TREE-MAPS: 2-D SPACE-FILLING APPROACH](#)
By Ben Shneiderman

[João Moura Pires](#) [STARResearch.NET](#) [Contact Me](#)

Web Site: Summaries

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[T01]: Course overview

06 Mar 2020, 04:10 PM Filed in: [Lectures](#)

What we mean by "Interactive Data Visualization"? What is Visualization? Why Visualization is important? Early Visualizations; Visualization today; Visualization and other fields. Visualization Process; The role of Perception.

Course Organization and Overview: Syllabus; Bibliography; Evaluation rules; important dates, etc..

Recommended Readings: (i) Interactive Data Visualization: Foundations, Techniques, and Applications, Matthew O. Ward et al, 2010, pages 1 - 33.

Recommended Activities: (ii) Visit the various sections of this site; (iii) instal Tableau software on your computer. Follow the link <http://www.tableau.com/academic/students>.

To Know:

- What is Visualization.
- The main "applications" of Visualization.
- Why Visualization is important.
- Key aspects of today Visualizations.
- Some important landmarks of early visualizations. For each one why is a landmark.
- The relation between Visualization and computer graphics. The differences between them.
- The relation of Visualization with other fields.
- The general steps of a Visualization Process
- The role of Perception.
- The role and the importance of the user.

Web Site: Evaluation section

IDV 19/20

Interactive Data Visualization



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- Subjects

This area is dedicated in general to the evaluation process and more specifically to the team-work projects, namely important dates, and detailed instructions about the **registration of teams** and **registration of subjects**, **report delivering** and **team-work discussion**.

Important Dates

- **Team registration**: until **March 20th**
- **Subject specification**: until **April 24th**
- **Paper**: until **May 15th**
- **Code and Implementation**: until **June 5th**
- **Oral discussions**: from **June 10th** up to **June 12th**, with a previous appointment

Instructions

Team registration

The students have to create **teams with 3 students** and make a **team registration**. The team registration process requires to fill-up a google sheet already shared with you.

Subject definition

A registered team must register its subject choice for the Practical team-Work. The purpose of subject registration is to provide the teacher with a clear description of the chosen subject, to get a teacher's approval, and from that point you should keep your subject registration updated as you start the development. By doing that you keep an appropriate live summary of your project for you, for your colleague and for the teacher. You may update your subject registration as many times you want. Please make your subject registration as clear and complete as possible. Consider the [general recommendations for your paper](#), mainly on Title, Abstract and Introduction.

References: the text books, the papers, the sites you use during the design and the implementation of your project

Software: list of software you will use in the development of your project

Development: you can use this section for further details and eventually to indicate a URL where the teacher can check your system.

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Important Dates

Week	Subjects	Event
1	Overview	
2	Introduction to Data Visualization	
3		Team registration: Mars 20th
4		
5		
6		
7		
8	Visualization Techniques	Subject Registration: April 24th
9		Test 1: April 27th
10		
11	Advanced Topics: Evaluation; Research directions	Paper: May 15th
12		
13		
14	Students Support	TP Implementation: June 5th
15	Oral Sessions	Test 2: June 7th; Oral Sessions

Important Dates - Project

- **Team registration** up to Mars 5th (**week 02**)
- **Subject Registration:** Up to April 24th (**week 08**)
- **Paper :** Up to May 15th (**week 11**)
- **Project Implementation:** Up to June 5th (**week 14**)
- **Project Oral discussion:** 10 to 12 June (**week 15**)

Project - Search for interesting datasets

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It's up to you to select one or more datasets and to propose to analyze the available data to answer questions that you propose or find some patterns using Data Visualization Techniques.

The first thing is to find the data that you are interested in.

- Consider the following article "[The 50 Best Public Datasets for Machine Learning](#)".
- The most well know source of public datasets, [Kaggle](#)
- From google <https://datasetsearch.research.google.com>
- [Open data from Lisbon](#)
- [Portdata](#) - Contemporary Portugal Database

The second task is to search for Data Vis solutions built on the top of the data you consider and try to find what questions do you want to address with the selected data.

The third task should be to propose your how innovative Interactive Data Visualization to address your selected questions

Script for Project

- **Look for dataset** that would be the main dataset
- Define some **research questions** that you want to address
- Eventually find **adicional datasets** to complement the main dataset
- **Write:**
 - ◆ **Title** and the **Abstract**
 - ◆ The **description of the dataset(s)** and the **research questions**
- **Subject registration**
 - ◆ Receive feedback, correct until you get a green light
- **Paper delivery**
 - ◆ Extend the subject registration with the **state of the art** and **your proposal**

Important Dates

Week	Subjects	Event
1	Overview	
2	Introduction to Data Visualization	
3		Team registration: Mars 20th
4		
5		
6		
7		
8	Visualization Techniques	Subject Registration: April 24th
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10		
11	Advanced Topics: Evaluation; Research directions	Paper: May 15th
12		
13		
14	Students Support	TP Implementation: June 5th
15	Oral Sessions	Test 2: June 7th; Oral Sessions

A challenge for the week

Facts, Data and Visualizations - Covid-19

- **Check for Oficial Data**

- ◆ **Share (with the teacher) the links with data or reports or information**

- **Check for Data Visualizations**

- ◆ **Make your own evaluation, select the ones worth to be shared**

- ◆ **Share (with the teacher) the links with data or reports or information**

- ◆ **Next week we will discuss the shared material**

- ◆ **Start here**

- **<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>**

Further Reading and Summary

Further Reading

■ Recommend Readings

- ◆ Interactive Data Visualization: Foundations, Techniques, and Applications, Matthew O. Ward et al, 2015, pages 1 - 38.

■ Supplemental readings:

- ◆ Cholera map's John Snow:
 - https://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak
- ◆ Napoleon
 - https://en.wikipedia.org/wiki/Charles_Joseph_Minard
- ◆ William Playfair:
 - https://en.wikipedia.org/wiki/William_Playfair
- ◆ Florence Nightingale:
 - https://pt.wikipedia.org/wiki/Florence_Nightingale
- ◆ Periodic table:
 - https://en.wikipedia.org/wiki/Periodic_table

Check - vis25timeline

What you should know

- **What is Visualization.**
 - ◆ Understanding the data => take decisions
- **Data Visualization can be extremely powerful**
 - ◆ Uncover new patterns; confirm hypothesis;
- **Why Visualization is important.**
 - ◆ Stats not enough; communication needs; exploratory needs
- **Key aspects of today Visualizations.**
 - ◆ Interactions; visual abstractions; multiple (linked) visualizations.
- **The general steps of a Visualization Process**
 - ◆ Raw data -> data -> viz structures -> images -> **perception** + **feedback**
- **The role of Perception.**
 - ◆ The role and the importance of the user.

Recommended Actions

- Read the available information on the Web Site
- Update your calendar (or subscribe the calendar)
- Be aware of VID News ([VID RSS Feed](#))
- Find partners for your team work
 - Make the registration until March 30th
- Check the [Summaries section](#) and follow its recommendations
- Install Tableau software
 - <http://www.tableau.com/academic/students>